GEOLOGY
OF THE
GOLDFIELDS
OF
BRITISH GUIANA.

J. B. HARRISON.

Frontispiece.]

PLATE 1.

KAIETEUR FALL,

POTARO RIVER, ESSEQUIBO, BRITISH GUIANA.

The perpendicular height of the fall is 741 feet, or nearly five times the height of Niagara. The width varies from 350 feet in the dry season to 400 feet in the rainy season, and the depth of water passing over similarly ranges from a few feet to 20 feet. The river, even in very dry season, has a depth of 35 feet about a quarter of a mile above the fall. The face of the fall is composed of sandstone with a capping of harder conglomerate.

Photo by C. W. Anderson.

THE

GEOLOGY OF THE GOLDFIELDS

OF

BRITISH GUIANA

BY

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WITH

HISTORICAL, GEOGRAPHICAL, AND OTHER CHAPTERS.

BY

FRANK FOWLER,

Commissioner of Lands and Mines.

AND

C. WILGRESS ANDERSON, F.G.S., F.R.G.S.,

Government Surveyor.

AND WITH AN

APPENDIX

GIVING THE LAWS AND REGULATIONS GOVERNING THE MINING INDUSTRY.

PUBLISHED BY THE DIRECTION OF

HIS EXCELLENCY SIR FREDERIC M. HODGSON, K.C.M.G.,

GOVERNOR OF BRITISH GUIANA.

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ERRATA.

PAGE

5, line 18, for "left" read "right."

11, ,, 45, ,, "Macouria" read "Makauria."

24, ,, 8, ,, "felstones" read "felsite."

36, ,, 41, ,, "granitic-gneiss" read "granitite-gneiss."

42, ,, 2, ,, "Granite-gneiss" read "Granitite-gneiss."

79, in the 3rd column of the 2nd table,

line 2, for "3.9" read "11.8."

,, 5, ,, "11.8" read "3.9."

107, ,, 30, ,, "150" read "180."

215, ,, 4, ,, "sedimentary" read "sedentary."

224, ,, 5, ,, "1s." read "£1 0 10."

Plate VI 1, for "Granitite" read "Granite."

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ILLUSTRATIONS.

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OF

SECTIONS OF TYPICAL ROCKS.

THE GEOLOGY OF THE GOLDFIELDS OF BRITISH GUIANA.

CHAPTER I.

INTRODUCTION.

The geological reconnaissances, the results of which are described in the following pages, were commenced in 1897 by an examination of the North-Western district of the colony, and completed in 1905 by one of the Berbice River district.

The examination of the North-Western district was instituted by the Government, at the request of some of the mining companies interested in that district, to ascertain the truth or not of allegations made that it was a volcanic district and not rich in auriferous rocks. The examination having shown the incorrectness of this view, on the motion of the Hon. G. Garnett, the Combined Court voted the money necessary for the examination of the other mining districts of the colony.

The preparation of this Handbook is due to a suggestion by His Excellency Sir Cavendish Boyle, K.C.M.G., Governor of Mauritius, while acting in 1901 as Governor of British Guiana. Its completion has been kept back by the delay occasioned by the examination of the Cuyuni River district and the carrying out of the many analyses and petrographical examinations required.

Concise chapters dealing with the history of mining enterprise in British Guiana, and with hints to travellers through the colony, have been contributed by F. Fowler, Esquire, Commissioner of Lands and Mines.

Mr. C. Wilgress Anderson, F.G.S., F.R.G.S., of the Department of Lands and Mines, has contributed a chapter descriptive of the natural features and topography of British Guiana, with a sketch of its various inhabitants, and one dealing with the facilities for transport in the Colony.

A map showing the structure of the northern portion of British Guiana has been recently published. The results of the geological reconnaissances described in this book are recorded on it. It was drawn by C. Wilgress Anderson, Esquire, F.G.S., F.R.G.S., the geological details being inserted by myself.

During the journeys in the North-Western district, in the Essequibo, Potaro and Demerara district, and in the Mazaruni and Puruni district, I was accompanied by H. I. Perkins, Esquire, I.S.O., F.G.S., at that time Acting Commissioner of Mines, now Surveyor-General in the colony of British Honduras.

In the journeys on the Lower Essequibo, Groete Creek and Cuyuni River districts, Mr. C. Wilgress Anderson, F.G.S., F.R.G.S., accompanied me and made the necessary route surveys. My thanks are due to these gentlemen for the great assistance they have rendered, both during the journeys and in the preparation of the various reports and maps. Mr. R. Ward, Agricultural Assistant in the Department of Science and Agriculture, accompanied us during most of our journeys, and rendered much assistance in the collection of rock specimens, and by making visits to places which, on account of lack of time, were otherwise inaccessible to the expeditions.

The accounts of the structural geology of part of the Upper Demerara River and of the Mazaruni River above Sororieng, are by Mr. Perkins; while I am indebted to Mr. Anderson for those of the Cuyuni River above Devil's Hole, of the Venezuelan and Brazilian boundaries districts, and of the Berbice River.

Much use has been made, during the expeditions and the preparation of this account, of the Geological Reports of Messrs. Brown and Sawkins, of publications relating to the geology of Omai, by Dr. Emil E. Lungwitz, Ph.D.; of the "Geologisch-bergmännische Skizzen aus Surinam," by Dr. G. C. du Bois; of the "Guide Pratique pour la recherche et l'exploitation de l'or en Guyane Française," by Dr. Levat, and of the published papers by Mr. E. G. Braddon. Where feasible my obligations to them are noticed in the text.

I am also under obligations to the Indians and others who were with the expeditions as boat-hands, and especially to Captain George Cozier, who accompanied the expeditions to the Essequibo and Potaro Rivers, to the Mazaruni and Puruni Rivers, and to the Cuyuni River as steersman and boat-captain. During these expeditions he attained considerable knowledge of the work of geological reconnaissances, and his skill as steersman, his knowledge of the topography of the rivers, and his energy and devotion to his work proved of high value.

I have received much assistance in making the numerous analyses and assays required from John Williams, Esquire, F.C.S., Chief Assistant Analyst in the Government Laboratory.

My special thanks are due to Dr. J. Harris Teall, F.R.S., the Director-General of His Majesty's Geological Survey of Great Britain, for the great assistance he gave me by examining many of the microscopic slides prepared from the rocks of the North-Western and of the Essequibo-Potaro districts.

G. F. Franks, Esquire, M.A., F.G.S., of Queen's College, has from time to time assisted me by examining microscopical slides prepared from the samples of rock collected during the expeditions, and by reading many of the proofs of my reports.

Acting upon the experience recorded by Messrs. Brown and Sawkins in their Reports on the Geology of British Guiana showing that it was practically useless to attempt the examination of the auriferous districts of the Colony except during the drier parts of the dry seasons, when the waters of the rivers are very low, and the rocks are exposed, the field work, or more correctly the river work, has been done during such times.

It has been objected that my accounts of the structure of the district are based mainly on the rocks exposed in the channels of the rivers. But the reason for this is obvious—there are very few other exposures of the country rocks.

The rocks of the hills, as well as those in the valleys, are almost invariably covered by heavy forest growths upon great thicknesses of clay and sandy clays, the results of the decomposition of the rocks *in situ*, which more or less completely hide the geological structure of the country. A geologist may walk for many hours along the trails and paths which here and there lead through the forest and not see any indications of what the country is. The rocks he will most frequently meet with will be masses of quartz and of concretionary ironstone. Very occasionally he will find in ravines near the heads of small streams and creeks natural sections showing the country rock.

But during very dry seasons the beds of the rivers become exposed over large areas, and their courses give excellent natural sections along which the structure of the districts can be readily studied. The scour of the river usually has removed the softer decomposing portion of the rocks, and excellent representative specimens of them can be easily obtained.

The rocks collected during the journeys have been subjected to petrographical and chemical examinations, and the general results are recorded in the chapter dealing with petrography.

Those desirous of studying the geological structure and petrography of the Guiana Goldfields in fuller detail than appears in this Handbook are referred to the following:—

"Reports on the Physical, Descriptive and Economic Geology of British Guiana." By C. B. Brown, F.G.S., and J. G. Sawkins, F.G.S. . . . . 1875.

"Über die Regionalen Veränderungen der Goldlagerstätten" By Dr. Emil E. Lungwitz . . . . 1899.

"The Lixiviation of Gold Deposits by Vegetation and its Geological Importance"; "The Placers of British Guiana." By Dr. Emil E. Lungwitz, from the *Mining Journal, Railway and Commercial Gazette* . . . . . . 1900.

"Geologisch-bergmannische Skizzen aus Surinam." By G. C. du Bois . 1901.

"Beitrag zur Kenntnis der Surinamischen Laterit und Schutzrindenbildungen." By G. C. du Bois . . . . 1903.

"Guide Pratique pour la recherche et l'Exploitation de l'or en Guyane Française." By Dr. Levat . . . . 1898.

"British Guiana and its Mining Development." By E. G. Braddon, from *The Mining Journal, Railway and Commercial Gazette* . . . . 1904.

"The Geology of the North-Western District." By J. B. Harrison and H. I. Perkins . . . . 1897.

"The Geology of the North-Western District" (Part II., "Petrology"). By J. B. Harrison. With Notes on the Microscopic Structure of the Rocks, by J. J. Harris Teall, M.A., F.R.S., etc. 1898

"Rocks of the Aruka District, North-Western District." By J. B. Harrison. 1898

"The Geology of the Essequibo, Potaro, Konawaruk and Demerara Rivers." By J. B. Harrison and H. I. Perkins . . . . 1900.

"The Geology of the Mazaruni and Puruni Rivers." By J. B. Harrison and H. I. Perkins . . . . 1900.

"The Geology of the Lower Essequibo River, the Groete Creek District and the Lower Cuyuni River." By J. B. Harrison and C. Wilgress Anderson 1903.

"The Geology of the Cuyuni River, from Arawak Matope to the Akarabisi Creek." By J. B. Harrison and C. Wilgress Anderson . . . . . . 1905.

"The Petrography of the Cuyuni and Mazaruni Districts, and of the Rocks at Omai." By J. B. Harrison. With Notes on the Geology of part of the Berbice River, by C. W. Anderson . . . . 1905.

"Explanation of the Geological Map of Parts of Barima and Barama River." By J. B. Harrison . . . . 1901.

"Explanation of the Geological Map of Parts of the Essequibo, Potaro, Konawaruk and Demerara Rivers." By J. B. Harrison . . . . . . 1901.

"Explanation of the Geological Map of Parts of the Mazaruni and Puruni Rivers." By J. B. Harrison . . . . 1901.

"Explanation of the Geological Map of Parts of the Essequibo and Cuyuni Rivers." By J. B. Harrison . . . . 1906.

CHAPTER II.

(F. Fowler, *Commissioner of Lands and Mines.*)

HISTORY OF GOLD MINING IN BRITISH GUIANA.

The first recorded instance of mining for gold in British Guiana was in 1720, when an expedition sought for gold in Berbice; but the results were not satisfactory, and the idea of finding any was abandoned. Another attempt was made in 1740, when the directors of the Dutch West India Company sent a mining engineer named Hildebrand to explore the Mazaruni, Cuyuni and Essequibo Rivers. This also was unsuccessful, though gold, silver and copper were reported to have been found. In 1743 another expedition was despatched by van Gravesande, then the Governor of Essequibo, which, like its predecessors, ended in failure.

That gold existed in the colony in payable quantities was long suspected, especially as it had been so found in French and Dutch Guiana as well as in Venezuela; but it was not until 1863 that any well-organised attempt was made to prove this. In that year a Company, composed of local and of English capitalists, and called "The British Guiana Gold Company," sent an expedition to the Cuyuni River. Gold-bearing quartz was discovered at Wariri on the left bank of the river about four days' boat journey from Bartica, but owing to this district being in dispute between British Guiana and Venezuela after starting work and erecting a small stamping-mill the undertaking was abandoned.

In the eighties attention was again turned to the mining possibilities of the colony, and several expeditions were sent to the Essequibo and Cuyuni districts, their results being very encouraging. No records are obtainable of the yields prior to the year 1884, in which the export of gold from the colony is recorded as amounting to 250 ounces. Subsequent to this time systematic and more expensive prospection was carried on, resulting in rich finds being made in the Cuyuni, Puruni and Essequibo Rivers districts from 1886 to 1888. There was no longer any doubt that gold existed in paying quantities in the colony, and many of its inhabitants turned their attention to prospecting for it.

Legislation now became necessary, and the Government brought into force the first set of mining regulations in 1886. Viewed in the light of subsequent experience these were very cumbrous, but the fact that the gold-mining industry was recognised by the Government gave a great impetus to it. Speculation became rife in the colony, and many companies were formed to work the claims already located and to prospect in new country. This induced many of the labouring population to go to the interior, wages being at very high rates.

The method then adopted and since carried on successfully to obtain the precious metal was that of alluvial washing, the Omai district on the left bank of the Essequibo River being one of the most successfully worked in this way. It has been roughly estimated that about 24,000 ounces of gold were obtained from the Omai placers in two and a quarter years from the commencement of working them.

Attention was directed in 1890 to the numerous outcrops of quartz which were found to exist in some parts of the gold-bearing districts of the colony, and miners from Europe, North America and South Africa visited the colony for the purpose of testing the capabilities of these reputed reefs. Large areas were located, notably at Kanaimapoo and at Appaparu on the Demerara River, and in the vicinity of Arakaka on the Barima River. Companies were floated to work these locations, and quartz-crushing mills were erected on several of the properties. Unfortunately none of these enterprises were successful, the Barima mine being the only one which produced gold in any quantity from the quartz crushed, and after producing about 8,000 ounces of raw gold in two years this mine was closed down in 1897. The cause of the non-success of the mines was largely the installation of the mills, and the commencement of crushing operations before the mines were sufficiently developed to ensure their mills being fully supplied with gold-bearing quartz.

Recently the properties at and near the Barima mine have been acquired by an English company, and the work of re-opening and developing the mines has been systematically carried on, with very favourable indications.

Towards the latter end of 1903 the outcrop of a gold-bearing quartz reef was discovered on the claims owned by a man named Peters, which are situated on the right bank of the Puruni River, a tributary on the left bank of the Mazaruni River. These claims were purchased by an American syndicate, which at once commenced development work, resulting in a very large reef of auriferous quartz being exposed. A mill with fifteen stamps has consequently been erected there and crushing operations started. The prospects of this mine are very promising.

This successful result has attracted attention, and prospections for auriferous quartz reefs are now being carried on in many of the mining districts of the colony.

After alluvial washing had been carried on for some years with marked success at Omai in the Essequibo River district the various claims located there were purchased by a syndicate of German capitalists styled the Guiana Company, and after very extensive prospecting machinery for the purpose of working the ground by hydraulicing was erected. This work has been carried on since January, 1903, with satisfactory results, 27,123 ounces of gold having been the result of the work to the 31st March, 1907. As subsidiary to the hydraulicing work dredging has been employed at Omai with some success.

The bed of the Konawaruk River is in places gold bearing, and a commencement of dredging operations has been made there with very promising returns.

Land on the banks of the Mahdia creek, Potaro River, has also been granted for dredging purposes. Very large areas of land exist in the colony, which carry gold in quantities that will pay to work either by hydraulicing or by dredging.

During the earlier years of the gold-mining industry from time to time miners when washing up the gold productions found small diamonds in the pans. The occurrence of these stones attracted little attention until an expedition to the upper reaches of the Mazaruni River in the year 1890, whilst seaching for gold found small diamonds in some numbers. During the next two or three years other expeditions to the same district were made with the object of searching specially for the gems ; but although diamonds were found in considerable numbers their value was not sufficient to cover the very heavy expenses of their exploitation, and the search for them practically ceased until 1900. In that year a company, styled "The British Guiana Diamond Syndicate," located 2,000 acres of land on the Putareng creek, Mazaruni River, and obtained from the Government a concession to mine thereon for precious stones. This was followed by a rush to this district, where large areas of land were located for which licenses were taken out. The output of diamonds for the year 1900-01 amounted to 4,981 stones, weighing 740·6 carats. Since that year diamond washing has been continually pursued in the Putareng district.

Diamonds have been discovered in the Kuribrong River, a tributary of the Potaro River, and a considerable number of stones of good quality and fair size have been found there.

So far the stones found in the colony have been small, averaging from ten to fifteen to the carat.

The total number of diamonds recorded at the Department of Lands and Mines from the inception of the industry of mining for diamonds in 1900 to March 31st, 1907, amounted to 731,240, weighing 49,590 carats.

It has been found necessary from time to time to amend the Regulations in connection with the mining industries. In 1903 all the regulations relating to mining, both for precious metals and for gems, were amended where necessary, and consolidated. They have since been slightly amended in some minor details, and have been published in a volume handy for reference, and form an Appendix to this Handbook.

The following table, taken from the official records, shows the progress of the gold-mining industry since the year 1884:—

Years.	Ounces of Gold.	Years.	Ounces of Gold.
1884–85	250	1896–97	127,479
1885–86	939	1897–98	121,491
1886–87	6,518	1898–99	113,114
1887–88	10,986	1899–1900	112,790
1888–89	20,216	1900–01	114,102
1889–90	32,332	1901–02	101,332
1890–91	66,864	1902–03	104,525
1891–92	110,555	1903–04	90,336
1892–93	134,124	1904–05	95,864
1893–94	138,528	1905–06	94,363
1894–95	132,995	1906–07	85,506
1895–96	121,285		

The total recorded production of gold has been 1,936,495 ounces, valued in round figures at £7,240,000.

The following statement shows the gold obtained by companies from claims in the various fields in the colony during the years 1892 to 1907:—

	Periods.	Ounces.
North-Western District—		
Arakaka Placer and Mining Company, Barima	1894–1901	11,385
Barima Gold Mining Company . .	1893–1900	8,905
Cuyuni River—		
Pistano and Richards	1894–1900	14,212
Mazaruni River—		
Barnard Syndicate	1894–1906	26,139
Puruni River—		
Peters Mine	1905–1907	17,615
Essequibo River—		
Omai Gold Mining Company . . .	1892–1907	58,794
Potaro District—		
Inflexible Syndicate	1894–1900	12,387
Compromise Syndicate	1895–1900	5,028
Mahdiana Company	1894–1900	9,395
Rhodius Syndicate	1894–1900	17,190
Garnett Syndicate	1894–1906	42,505
Hope Placer	1894–1899	8,378
Prosperity Placer	1894–1899	4,060

The following large nuggets have been found in the undermentioned districts:—

Jimbo, Barima	one	weighing	333	ounces.
Konawaruk Creek, Potaro	,,	,,	274	,,
Tiger Creek, Potaro	,,	,,	106	,,
Puruni River	,,	,,	90	,,
Omai	,,	,,	84	,,

CHAPTER III.

(C. WILGRESS ANDERSON, F.G.S., F.R.G.S.)

GENERAL PHYSICAL AND TOPOGRAPHICAL FEATURES OF BRITISH GUIANA.

Situation and Extent.—The region called Guiana, or Guyana, stretches along the northern coast of South America from the mouth of the Orinoco River to that of the Amazon River, and inwards to Brazil.

The only European possessions in South America are three in number, and are situated on the central portion of this territory, which is divided into the colonies of the British, Dutch, and French Guiana.

Of these colonies, the most westerly is that of British Guiana, which extends from the eastern limits of Venezuela, westward to Dutch Guiana, and north of Brazil to the coast on the Atlantic Ocean, its extreme limits touching the parallels of 0° 41′ and 8° 33′ 22″ north latitude, and the meridians of 56° 20¼′ and 61° 23′ 24·7″ west longitude.

British Guiana has a seaboard of about 270 miles trending in a south-easterly direction, with a mean depth of about 500 miles, and is equal in extent to the combined size of England, Scotland and Wales, the area being about 90,000 square miles, most of which is densely covered with exuberant primeval forest, but in some parts there are broad open flats and undulating grassy plains, or savannahs, and mountainous grass-clad country.

Physical Features. The Alluvial Belt.—The colony may be divided broadly into two low-lying belts near the coast and a hilly and mountainous hinterland, which constitutes by far the largest area.

The coast lands are flat and for the most part swampy, being depressed slightly below the level of ordinary spring tides, so that sea-walls and other defences have had to be constructed to protect the settled parts of the coast lands from being flooded by high tides. They form part of an alluvial belt which rises gradually from the sea-level and extends inland for a distance varying from 10 to 40 miles, and which is composed of variously coloured clays with intermediate layers of sand and peat, the latter being locally known as pegass.

The margins of this formation along the sea and rivers are covered with a dense growth, consisting principally of mangrove (*Rhizophora mangle*) and of courida (*Avicenna nitida*), which form natural sea defences, the former being found along the western and the latter along the eastern parts. Behind this growth are flat grassy savannahs interspersed with forest, consisting mostly of Aeta and Trooli palms (*Mauritia flexuosa* and *Manicaria sauifera*), whilst in some parts the land is covered with a dense jungle. It is on this belt that all the sugar estates and by far the greater part of the cultivated areas are situated.

The Sand and Clay Belt.—The alluvial belt is succeeded by a slightly elevated and undulating belt composed of sandy and clayey sedentary soils, derived from the disintegration of the various country rocks *in situ*, and traversed in some places by sand dunes which rise from 50 to about 180 feet above the sea level. This second belt commences at the Waini River, in the North-Western district, and gradually increases in width as it extends towards the eastern boundary on the Courantyne, in the vicinity of which it attains its greatest depth at about 100 miles inland. Grass-covered downs occur on the banks of the Berbice and Courantyne Rivers, but the greater part of this tract consists of high forest, and along the river margins and in the low valleys Mora trees (*Dimophandra mora*) grow plentifully.

The Hinterland.—Beyond these belts, southwards, the country rises between the river valleys, which are in many parts swampy, and as it approaches the sources of the larger rivers attains a height of about 900 feet above the sea level at the source of the Takatu, the western boundary, and about 400 feet above the sea at the source of the Courantyne, the eastern boundary. This more elevated portion occupies about eleven-twelfths of the area of the colony. It is diversified by numerous low hills and valleys, and contains three principal mountain ranges, several irregularly distributed smaller ranges, and in its southern and eastern parts many scattered, isolated mountains, none of the last mentioned being more than 1,500 feet above sea-level.

The eastern portion is almost entirely forest-clad, yet the country on the western side of the colony, between the Rupununi and Ireng Rivers and extending southwards from the Pakaraima Mountains to the Kanuku range consists of an almost flat grass-clad plain or savannah, elevated about 300 feet above sea-level, in which, in the vicinity of and bordering upon the many streams by which it is watered, are patches of woodlands. From the Kanuku Mountains southwards to about six miles from the sources of the Takatu and from that river eastwards to a considerable distance beyond the Rupununi there is an extensive and undulating elevated savannah with similar patches of woods along the valleys of the many streams by which it is drained. Beyond this the extreme southern part of the colony is entirely forest-clad.

PRINCIPAL TOPOGRAPHICAL FEATURES.

On looking at the map of the colony the most striking features in it are the many large rivers by which the country is traversed, and the numerous tributaries and branch-streams by which it is copiously watered, together forming a vast net-work of waterways over the colony which, in the absence of roads, furnish a ready, if somewhat difficult, means of access to the interior.

[To face page 10.

PLATE 2.

KAIETEUR FALL

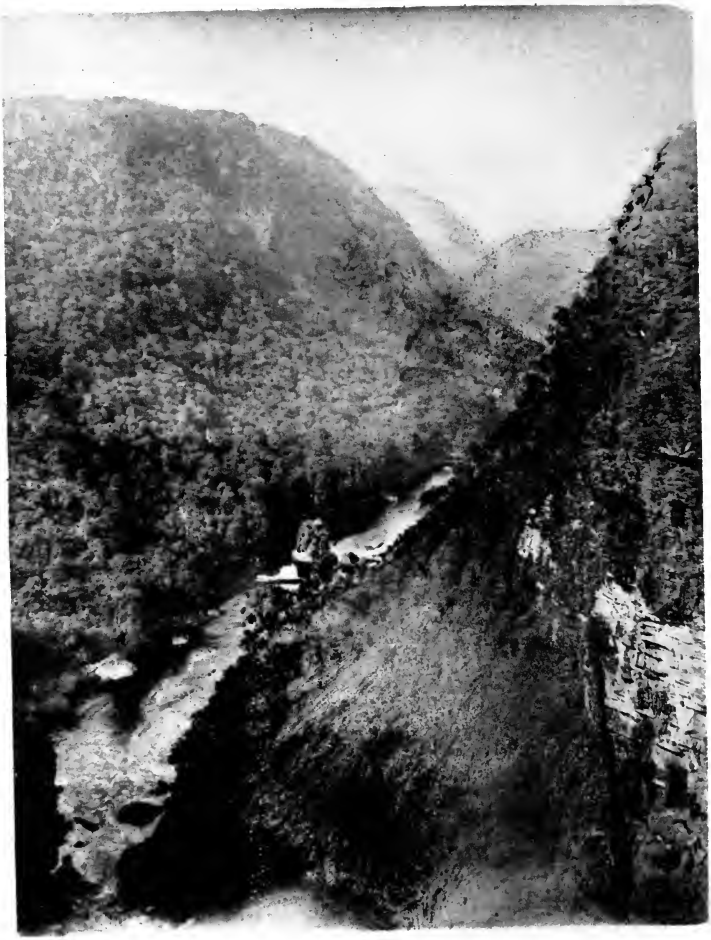
(IN RAINY SEASON),

SHOWING CONGLOMERATE LEDGE AND CAVE.

Photo by C. W. Anderson.

To face page 11.]

PLATE 3.



VIEW DOWN THE KAIETEUR GORGE

FROM THE

KAIETEUR FALL, POTARO RIVER.

Photo by C. W. Anderson.

All the rivers of the colony are impeded above where the tide reaches at various distances from the coast by numerous rapids, cataracts and falls, which render the navigation of the upper reaches difficult, and in some parts dangerous.

The largest of these falls is the Kaieteur on the Potaro, which has a width, in the rainy season, of nearly 400 feet, with a perpendicular drop of 741 feet over an indurated bed of conglomerate overlying relatively soft strata of sandstone, and which is succeeded for about three miles below by a series of very large cataracts having a further drop of 81 feet.

Rivers.—Of the numerous river-systems there are six principal ones, viz.:—

(1.) The Essequibo and its principal tributaries the Mazaruni and Cuyuni;
(2.) The Courantyne and its tributary the New River;
(3.) The Berbice and its tributary the Canje;
(4.) The Waini and its tributary the Barama;
(5.) The Demerara;
(6.) The Barima.

These, together with the following smaller ones, the Abary, Mahaicony, Mahaica, Boerasirie, Pomeroon and Maruka Rivers, flow to the Atlantic Ocean.

In addition to the above-mentioned rivers, there are the Takatu and its tributary the Ireng, which meet together at 3° 34′ North latitude and form the Brazilian boundary. The Takatu flows thence to the Rio Negro, the waters of which join the Amazon.

The Essequibo, the largest river in the colony, rises in 0° 41′ north latitude, about 850 feet above the sea level and flows in a northerly direction for some 600 miles. It is joined at Bartika, about 40 miles from its mouth, by the Mazaruni River, a tributary which is itself joined at Cartabo, five miles above Bartika, by another tributary called the Cuyuni River, all these combining to form an estuary with a width of about three miles below their junction, and which expands to a width of fourteen miles at the mouth containing as it approaches the sea three large islands, each of which is about twelve miles in length, and in addition many smaller ones. The river is navigable for large vessels as far as Bartika, and for small launches to the foot of the first rapids, eighteen miles above that point. Beyond this its course is broken by many rapids, and cataracts, and about five miles above the junction of the Rupununi the Essequibo River is practically unnavigable on account of the many long series of cataracts and falls which obstruct its course.

Of the smaller tributaries flowing into the estuary of the Essequibo River, the most notable are the Supinaam, the Groete and the Macouria.

The largest tributaries of the Essequibo are the Mazaruni and Cuyuni Rivers, the Potaro, the Siparuni and Burro-burro, the Rupununi and Rewa, the Kuyuwini, and the Kassi-kidju Rivers.

Of these rivers the Mazaruni has the most singular course. Rising in the Merumé Mountains about 2,400 feet above the sea-level it flows southward for some distance, then curving round to the west it turns in latitude 5° 34′ north in a north-westerly and then northerly direction to the Peimah Falls. In this part of its course many lofty falls occur Thence following a south-easterly direction to the mouth of the Merumé, it approaches to within twenty miles of its source, having described roughly almost an oval. Continuing with a tortuous course south-easterly to the Teboco Falls in north latitude 5° 45′ 29″, it turns thence to the north-east and flows through comparatively level country to join the Essequibo. Below the Peimah Falls bars of rock cross the river in many places, giving rise to numerous rapids and low cataracts. Its most important and largest tributaries are the Puruni, Merumé, Kamarang, Kako and Kukui Rivers.

The Cuyuni, which rises in Venezuelan territory, through which it flows for a considerable distance, forms the Venezuelan boundary of the colony from below the mouth of the Wenamu to that of the Akarabisi, along both of which tributaries the Venezuelan boundary extends as far as their sources. It has a generally westerly course as far as Tinamu Cataract whence it turns towards the south-east and follows this course until it joins the Mazaruni. It flows through a hilly although a comparatively low part of the colony, but its course is nevertheless obstructed by many rapids and cataracts, which form serious impediments to navigation. Of the comparatively few large tributaries of the Cuyuni the following may be mentioned—the Oko, Arimu, Kopang, Iroma, Akarabisi, Ekereku and Wenamu Rivers.

The Potaro and Siparuni Rivers, and the tributary of the latter, the Burro-burro, which falls into it about five miles above its mouth, take their rise in the Pakaraima Mountains and flow through country covered with high forest. Their courses are broken by many high waterfalls and cataracts, the highest and most striking of these being the Kaieteur situated on the Potaro River which has already been described.

The Rupununi River joins the Essequibo in 4° 2′ 52″ north latitude, and gives access during the rainy seasons to the elevated grass-clad plains or savannahs, on which at the present time a large number of cattle are being raised. During the height of the dry seasons the river becomes very shallow, its course being impeded by many sandbanks and rapids, and during this time it can only be ascended with great difficulty and much loss of time, or sometimes not at all. Its many inlets and large lake-like ponds on both banks form a feature common also to the upper parts of the Berbice River. Its largest tributary is the Rewa or Illiwa, which is itself joined by the Quitaro, and both flow through country covered with high forests.

The Courantyne River, which forms the eastern boundary between the colony and Dutch Guiana, rises in 1° 48′ 30″ north latitude, about 140 miles to the east of the Essequibo River. The watershed from which it rises separates its head-waters from those of the rivers flowing to the Amazon system, and is only about 400 feet above sea-level. Its course is much impeded by many rapids and cataracts as far down as Timehri Rock, in latitude 4° 40′ north, below which it is navigable for sailing craft and the smaller river steamers. From its source it flows in a north-north-westerly direction approaching to within from twenty-five to thirty miles of the Essequibo River near the fourth parallel of north latitude, thence its course is north-north-east to the Atlantic Ocean, into which it discharges its waters by an estuary about seven miles wide. The principal of its few large tributaries are the New River, the sources of which approach those of the Essequibo River, the Aramatan, near the source, and the Nickeri, which enters near the mouth on the Surinam side.

The Berbice River is divided near its mouth into two channels by Crab Island, the width there being about three miles from bank to bank. The source of the Berbice River has not as yet been determined, but it is probably situated in the vicinity of the third parallel of north latitude. Its tortuous course through the low alluvial and sand and clay belts is navigable by sailing craft and steamers for a longer distance inland than are any of the other rivers of the colony. The steamer terminus is nearly opposite the mouth of the Ituni in 5° 33′ north latitude; but during the rainy seasons it is navigable for small craft as far as the first rapids at Marlissa, in 4° 45′ north latitude, to the foot of which the influence of the tide extends. In the dry seasons beyond the mouth of the Ituni the river becomes very shallow, its bed being filled by many broad and extensive sandbanks.

The first large cataract on this river is the Itabru, in 4° 49′ north latitude; thence to the Christmas Falls, in 4° 41′ 45″ north latitude, its course is obstructed by numerous rapids and low cataracts. Beyond this its course is sluggish. Both below and above Itabru a striking feature of the river is the many inlets and lake-like lagoons which occur on both banks, in some of which that now famous lily, the "Victoria Regia," was first discovered growing, and so named by Sir Robert Schomburgk. The largest of its numerous tributaries are the Canje, the Wironi, and the Wikki.

The Waini, with its confluent the Barama, together with the Barima River, and their many large tributaries and numerous streams, are situated in that forest-covered part of the colony known as the North-Western district, which extends from the Amacura River on the west (the upper part of this river forming the western boundary between the colony and Venezuela) eastwards towards and near to the Maruka River, and southward from the Atlantic Ocean to that portion of the Imataca mountains, which also form a part of the western boundary of the colony.

These rivers are of great importance, as they furnish easy means of access and transportation to and from the low-lying agricultural districts near the coast, and the gold-bearing, forest-clad districts further inland, for they are navigable by steamers and motor-launches for long distances inland. Only in the upper reaches for a short time during very dry weather do they become too shallow for launches to run. As the Imataca spurs are approached, their head-waters are broken by rapids and cataracts. An interesting and useful feature of all the rivers in and around this district are the many waterways by which, at varying distances inwards, they are connected with one another, and by which it is both possible and practicable to journey from one to another entirely inland. Indeed, the facilities for transportation, more especially in the parts nearest the sea, but throughout the greater part of this district are so great as to render the making of roads almost unnecessary, and it is for this reason that, although comparatively recently opened up, this part of the colony has perhaps been the most thoroughly explored.

The Demerara River, although commercially the most important and best known of all the rivers in the colony, is, compared with some of those already described, a small one. As the greater depth at the bar admits of large vessels entering this river with more security and ease than is the case with any of the other rivers in the colony, Georgetown, the capital and principal port of the colony, has been established on its east bank at its mouth, which is there three-quarters of a mile wide, and furnishes a safe harbour for the many steamers and sailing vessels which frequent the port. The Demerara River takes its rise in the small mountain-range called the Maccari, which is really an off-shoot of the great Pakaraima range. It has a generally northerly course, and flows between the Essequibo and the Berbice Rivers; the river is navigable for steamers for nearly 80 miles upwards from its mouth, and beyond this for launches for about 24 miles further up as far as the Malali Rapids, where the influence of the tide ceases. Above Malali the river is again navigable for launches as far as Kanaimapoo, above which are the Kumaparu Rapids, where the Demerara River approaches nearest in its course to the Essequibo River. The first great cataract on this river is situated a short distance above Kumaparu, in latitude 5° 18′ north, and is known as the Oruru-Malali or Great Falls. Beyond Oruru-Malali the river is sluggish, and is again navigable for boats as far as the Cannister Cataracts where it divides into two streams. Its forest-clad banks are flat as far up as the second or sand and clay belt, where the sand-hills occur and form the first high land.

The most important and largest of its many tributaries are the Madawini, Kamuni, Hauraruni, Haiama, Tenabu and the Manabadeen.

The smaller rivers of the colony flow almost, if not entirely, through the low-lying alluvial and the clay and sand belts. Of these streams the most important are the Pomeroon, Mahaica, Mahaicony and Abary. Being navigable for small craft almost up to their sources they afford easy means of transport to a large number of East Indian, Portuguese, and other settlers who have taken up grants of Crown land for agricultural purposes, and have established small farms along their banks.

Mountain Ranges.—One of the most prominent features of the country is the great central mass of mostly flat-topped mountains, known as the Pakaraima Group or Chain, which occupies the most

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PLATE 4.

SOUTHERN EDGE OF MOUNT RORAIMA.

Sandstone Mountain and Elevated Table-land 8,635 feet above sea level, and rising with perpendicular cliffs of about 2,000 feet to a height of about 5,000 feet above the surrounding plateau.

Photo by C. W. Anderson.

western portion of the interior of the colony, and stretches southward from the Cuyuni River to within 30 miles above the mouth of the Ireng River, and eastwards to the Essequibo River between the Potaro and Rupununi Rivers, whilst certain spurs of these mountains continue beyond the Essequibo River right across the colony as far as the Courantyne River.

The bulk of these mountains form a successive series of terraces and broad, undulating plateaus, with bold, and in some cases, perpendicular sandstone escarpments varying in height from about 1,200 feet to over 2,000 feet, and eventually forming a large undulating tableland at an average height of about 3,500 feet above the sea level. In many parts of the mountains and tablelands great and deep gorges have been eroded by the rivers and streams which traverse them. They attain their greatest height at Mount Roraima and Mount Kukenaam, both of which rise over 8,500 feet above the sea. The portion of this range, which extends westward and down the southern bank of the Mazaruni River to the vicinity of the Teboco Cataracts, retains the striking flat-topped features, and is known as the Merumé Mountains.

The elevated tableland (8,635 feet) of Mount Roraima is about twelve square miles in area, and on it the boundaries of the colony, with those of Venezuela and Brazil, meet at a common point. This very remarkable mountain, together with Mount Kukenaam, is a part of one of the most extensive sandstone formations on the globe, and they both rise with perpendicular cliffs of sandstone 2,000 feet in height above the base of the surrounding country. Although Mount Roraima has, to some extent, been explored by several parties, amongst whom may be mentioned Sir Everard im Thurn, and Mr. H. I. Perkins, I.S.O., Messrs. Quelch and McConnell, and the Venezuelan Boundary Commissioners, there still remain many unsolved problems to attract the attention of the explorer, and many further discoveries, more especially for the botanist, on this and the other somewhat similar remarkable mountains of this range.

Of these other sandstone mountains, the highest (about 7,000 feet above the sea) and most conspicuous are the curiously shaped ones of Iwalkarima, Eluwarima, Ilutipu, and Waiaka-piapu, the last-mentioned resembling an obelisk with a truncated head. None of these have as yet been explored. Many extraordinarily high waterfalls descend over the perpendicular cliffs of most of these mountains, those at Roraima and at Kukenaam having sheer drops of nearly 2,000 feet.

The Pakaraima Mountains are partly covered with forest, more especially in the valleys, but the greater portion of the elevated plateaus formed by this range are grass-clad, as are also the mountain-heights towards the south. In the valleys, and on certain of the slopes, high forests are found; but on the higher elevated plateaus the forest becomes very stunted and forms very dense and impenetrable thickets. The highest plateaus, such as Mount Roraima, are mostly bare, exposed expanses of rock, between the crevices of which grow many rare and curious orchids and other flowering plants, besides some low bushes and extremely stunted trees.

The sandstones of this range form mountain-caps, and terraces on the slopes, which rest on igneous and metamorphic rocks.

The part of the range of the Imataca Mountains, situated on the western extremity of the North-Western district of the colony rises from 800 to 1,500 feet above sea level, and divides the waters flowing to the Orinoco and Cuyuni rivers from those of the Amacura, Barima and Barama rivers which flow directly to the Atlantic Ocean. The watershed on this range extending from the source of the Amacura around the source of the Barima to the source of the Akarabisi, forms part of the western boundary of the colony with Venezuela. These mountains consist of igneous rocks, principally granite, quartz-porphyry, felsite, porphyrite and diabase, and are entirely forest-clad.

Lower spurs of this range extend eastwards beyond the source of the Waini River; and others reach as far as the Essequibo estuary, where they give rise to the Groete Creek and tributaries, and are known as the Blue Mountains.

The Kanuku Mountains.—Rising above the plains to the south of the Pakaraima Group are the Kanuku Mountains, none of which exceed 2,000 feet in height above sea level. The range commences at the Takatu, and continues in a westerly direction to the Rupununi River and beyond it as far as its tributary, the Quitaro, dividing the elevated savannah into two nearly equal parts. The Kanuku Mountains are entirely forest-clad.

Ranges and Mountains of Less Importance.—Of the smaller irregularly distributed ranges of mountains the following may be noticed:—The Maburima or Aruka Hills, near the Aruka River, which are the nearest hills to the coast, the Arisaru Hills, which extend from the lower Essequibo River to the Demerara River, their altitude being about 800 feet, the Maccari, between the Essequibo River and the Berbice River, and the Makarapan near the mouth of the Rupununi River; the two ranges last mentioned, although detached, are really outliers of the Pakaraima Range.

To the south of the above are the smaller ranges of Tamutan and Kusaad, situated between the Takatu and the Rupununi Rivers. Further south are the Karawaiming Mountains, in the vicinity of the source of the Quitaro River, and the partly grass-clad Ussari Mountains, which are near the source of the Kassi-kidju; both of these are unexplored. The most notable of the many isolated mountains are Sheriri, Piniette, Shuna, Wamuriak-Tawa and Win-Tawa. The main sources of the Takatu River are in the two last-mentioned.

It may be observed that, in conformity with the general distribution of heights which obtains in the two continents of America, the greatest heights are on the western limits of British Guiana, and that both the mountain ranges and the general level of the country diminish in height as they extend eastwards.

CHAPTER IV.

(C. WILGRESS ANDERSON, F.G.S., F.R.G.S.)

THE COUNTIES, TOWNS AND SETTLEMENTS OF BRITISH GUIANA.

The colony is divided longitudinally into the counties of Demerara, Essequibo, and Berbice. These three counties are to some extent proportionate in their areas to the lengths of the rivers on both sides of which they extend, and from which they take their names. That of Demerara, although by far the smallest, is the most important and the best known, for in it is placed the capital and the principal port of the colony. For this reason the name of this county is often, but erroneously, used to designate the whole of British Guiana.

Georgetown, the capital and principal port of the colony, is situated at the mouth of the Demerara river on its eastern bank in 6° 49′ 29″ north latitude, and 58° 09′ 52·5″ west longitude. (Site of the Georgetown post office.)

Georgetown has a good harbour, is well laid out on flat land with wide streets running at right angles to each other, and it contains a population of about 60,000.

The only other town in the colony is New Amsterdam, the former capital and the chief port of Berbice. It is situated about five miles from the mouth on the eastern bank of the Berbice River, and it has a population of about 9,000.

There are many large and small villages scattered along the sea coast, and on the margins of the rivers near the sea. In the county of Demerara the most important of these are Plaisance, Beterverwagting, Buxton, Belfield, Victoria, Fellowship, Den Amstel and Bagotville.

The most important places in the county of Essequibo are Suddie, situated on the west bank of the Essequibo river which is known as the Aroabishe or Arabian coast, and Bartika at the junction of the Essequibo and Mazaruni rivers. The Penal Settlement is very pleasantly situated on a low range of hills on the west bank of the Mazaruni River near the junction of the Cuyuni and Mazaruni Rivers.

In the North-Western division of this county the more important Settlements and Government Stations are Morawhanna, Arakaka and Barramanni.

THE POPULATION OF BRITISH GUIANA.

The estimated population of British Guiana is about 300,000, distributed as follows :—

On the settled coast-lands and the lower river banks there is a very mixed population. Negroes and coloured natives of the colony and of the West Indian Islands and East Indians preponderate. There are also a few Chinese and some half-bred South American Indians. There are a fair number of Portuguese, and comparatively few Europeans of other nationalities.

On some parts of the coast-lands, and especially in the hinterland, there are several tribes and sub-tribes of aboriginal Indians. The low swampy western sea coast between the Barima and the Essequibo rivers is favoured by the Warraus, who are only a small tribe. In the vicinity of these coast-lands and along the lower reaches of the rivers the Arawaks have their homes. They are the most civilised of all the aboriginal Indians.

On the Upper Barima, Barama and Cuyuni Rivers the few remaining Carib Indians dwell. There are many villages of Akawois and of their near relatives, the Patamonas, in the country around the Mazaruni, the Upper Potaro and the Ireng Rivers. In the vicinity of the Lower Rupununi River and that of the Lower Ireng River the country is sparsely peopled by the Macusis. Between the Upper Rupununi and the Takatu Rivers a small tribe called the Wapisianas dwell, and next to them, southwards, the Tarumas live. In the vicinity of the head streams of the Essequibo River an exceedingly interesting tribe called the Wai-wois have their habitat. Of these and of other small tribes along the southern boundary of the colony but little is at present known.

THE CLIMATE OF BRITISH GUIANA.

The climate of British Guiana is, as would be expected from its geographical position, hot, but it is not unhealthy. The temperature ranges from 75 to 90 degrees Fahrenheit. The seasons are divided into dry and wet. There is a long dry season from the middle of August to near the end of November, and a shorter, less sharply defined one in March and April ; the remaining two periods are termed the short and long wet seasons respectively. But the long dry season is the only one of these that is sharply marked in every year, the short dry season not unfrequently turning out a very wet one whilst the short wet season is at times a period of more or less well-marked drought.

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PLATE 5.

PATAMONA INDIANS

ON THE

KAIETEUR PLATEAU.

Photo by H. I. Perkins.

CHAPTER V.

GENERAL GEOLOGY.

1. *The Coast-Lands.*—The coast-lands of British Guiana form a plain of marine alluvium, interrupted in a few places by low hills of more or less decomposed country rock, as, for instance, the Maburima and Issorora hills in the North-West, and the hills at Santa Rosa and at Macaseema in the Pomeroon district. The alluvial plain is also traversed by lines of sand-dunes forming low ranges seldom exceeding thirty to forty feet in height in this part of the colony. The sands of these hills consist of white quartz, and the grains are, in the majority of cases, well rounded, showing their wind-blown origin. The alluvial deposits are of considerable but unknown thickness. As they rest upon beds of pipe-clay or impure kaolin it is a matter of great difficulty to decide whether the borings for underground waters, which have from time to time been made in various parts of the coast-lands, have been wholly in the alluvium, or have, as they certainly have done in some cases, penetrated through these beds into the underlying residuary clays. In places, however, the alluvial deposits have been proved for depths of over two hundred feet, and it is possible that in many places their thickness far exceeds this. The cores of the borings show that the alluvial deposits consist of beds of more or less indurated marine muds and sands which have been laid down so as to form beds of clay, of mixed clay and very fine siliceous sand, locally known as "caddy," and of siliceous sands varying much in texture,—some beds consisting of sand of extremely fine texture, others of coarser grain, while others again approach in character fine grits or gravels. In places some of the beds contain considerable quantities of decomposing vegetable debris, and these, when drilled into during deep well-sinking operations, in some cases give off inflammable mixtures of gases containing marsh gas in considerable quantities. In places the effusion of the gases has been accompanied by that of small quantities of petroleum, a decomposition-product of the organic matters. The geological age of these beds is uncertain, the lower parts may be of late Tertiary or of Pleistocene age, while the parts now bordering the coast-line are undoubtedly recent. I am inclined to think that their age is, in part at least, similiar to that of the Moruga sands of Trinidad. The sand-beds of these deposits are not unfrequently exposed in the cultivated parts of the coast-land, where they are known as sand-reefs. These form in places oval patches of land raised a few feet above the general level of the surrounding

argillaceous soils, and in others give rise to long narrow ridges somewhat raised above the general level of the land which they traverse. Their mode of occurrence indicates that they are purely local modifications of the alluvial deposits,—sands separated from the mass of the marine silt by the action of local currents and of the waves,—and thus the sand-beds form more or less lenticular beds occupying, as a rule, no great area. They are, in my opinion, very distinct from the beds of sand which characterise various phases in areas where the land is either rising or falling to any extent in the vicinity of a shallow sea.

The general evidence indicates that British Guiana occupies one of the most stable areas of the earth's surface,—one which has been very slowly rising through long ages,—this slow movement having given rise to the low rapids which usually mark the termination of the tide-way in the rivers, and possibly which has so altered the contour of parts of the continent on which the colony is situated as to change the main lines of drainage, and thus to make the rivers relatively small streams traversing the deeper parts of the courses and valleys eroded by their predecessors in earlier periods. During a stage in this slow upheaval the low hills already mentioned as occurring in a few places in the alluvial coast-land were in turn rocks and small islands in the shallowing sea which then surrounded them, as now they are surrounded by an apparently unbounded expanse of forest or of marsh.

A remarkable feature in parts of the alluvial coast-land is the occurrence of extensive beds of a kind of peat. This is locally known as "pegass," and consists of the more or less altered remains of ferns, mosses and sedges, and of other marsh-loving plants. It resembles in its general characters the upper layers of vegetable matter which are found in peat-bogs in temperate climates. As far as my observations go it is never as compact as in true peat. This is probably due to the deposits of it being seldom more than from two to four feet in thickness.

As pointed out by Sir Charles Lyell in his "Principles of Geology," a large portion of the sand and clays of the alluvial deposits has been brought by the currents from the mouth of the Amazon River; the burden brought by the present rivers of the colony from the higher districts through which they flow having been, during recent periods, a very subordinate factor in the accumulation of this widespread formation; although perhaps in earlier times, before the land had risen to its present level, the river-borne silt may have contributed a larger quota to the mass.

The Forest Lands and Residuary Deposits.—The alluvial strata extend to depths varying from five to, in places, as much as thirty-five miles from the coast-line, and rest upon beds described by C. B. Brown as "sand and clay deposits." This widespread formation may be seen for many miles along the courses of certain of the rivers, as, for instance, the Barima and the Barama in the North-Western district, the Essequibo and the Demerara Rivers. I have included in the alluvial deposits the portion of Brown's sand and clay deposits which appears to have been penetrated by the various borings which have been made in the coast districts. I regard the so-called valley-gravels, the sand and clay beds of C. B. Brown, as consisting mainly in the districts through which I have travelled, of arenaceous, argillaceous, and laterite beds arising from the decomposition and detrition of granites and gneiss, of quartz-porphyries and porphyrites, and of hornblendic and augitic rocks. They consist of more or less arenacous clays, varying from white and cream-coloured to dark-red or chocolate-coloured, according as they have been derived from acidic, non-ferruginous rocks or from basic, more or less ferruginous ones. These are generally covered by varying thicknesses of white, cream-coloured, yellow, or ochreous loams and sands, the latter characterising the districts where the leaching and elutriation of the decomposed rocks by the slightly acidic soil waters of the tropical forests and by the rain have been more intense. In places the sandy upper layers have been rearranged by the action of flowing waters or of the wind, the sands and gravelly particles have been collected into hollows, or form wind-blown dunes, the layers of which not unfrequently show false bedding. In the neighbourhood of masses of the more basic rocks the gravelly sands are in places cemented together by a limonitic cement, and give rise to ferruginous sandstones and conglomerates. Where the original rock which has decomposed *in situ* consisted of gneiss or of schist, with alternating layers of siliceous or feldspathic minerals and of ferro-magnesian ones, the variously tinged and differently coloured layers of sands, sandy clays, and more or less ferruginous earthy clays strikingly simulate stratified deposits showing more or less well-marked current-bedding. The laterites formed by the decomposition of the more ferruginous rocks are frequently covered by ironstone gravel, which locally attain a considerable thickness. These residual deposits cover and hide the true country over vast areas of the lower-lying parts of the colony, and form the characteristic sub-soils and soils of our forest regions.

The parts of the areas covered by these residuary deposits which abut upon the true alluvial beds are in many places traversed by long ranges of sand-dunes, giving rise to low hills which, as in the case of the range traversed by the Demerara-Essequibo Railway, may attain a height of somewhat over two hundred feet. As a rule, their heights do not exceed one hundred or one hundred and twenty feet. The sand of which the upper parts, at any rate, of these dunes (it is possible that in many cases they cover ridges of the residuary deposits) consist is glistening white quartz sand, the grains of which are usually uniform in size over relatively large areas, the majority being well rounded, thus accentuating the wind-blown origin of the dunes.

C. B. Brown notices that the beds form a low escarpment at the southern limit of the fluvio-marine deposit, and that this has been taken for a ridge running parallel to the coast. I have not had opportunities of repeating this observation, but accepting its accuracy I consider that the ridge approximately marks the shore-line which existed at the commencement of the deposit of the present fluvio-marine alluvium. Observations made in the forest regions since the time of Brown's geological reconnaissances of the interior of the colony have shown that the residuary deposits cover the country not alone on the plains of the lowlands but along the great river valleys and on the lower forest-covered parts of many of the hills and mountains. The heavy, at times torrential, tropical rains have carved out of the residuary coverings deep ravines and valleys; and the gravels, sands and silts derived from the eroded material have been laid down in the wider valleys and along the courses of parts of the rivers as fluviatile loams, gravels and sands. It is in these residuary deposits and in the gravels and earths derived from them that the readily available mineral wealth of British Guiana is found.

While a traveller through the heart of the forest-covered regions sees but little beyond this sedentary covering in its varieties as already described, and but for the very occasional occurrence of boulders of quartz, diabase, amphibolite, or of quartz-porphyry, and the somewhat rare exposure of the country in ravines and especially at small waterfalls, cannot recognise the fact that he is traversing a district the country of which consists of igneous rocks and not of stratified clastic deposits, one journeying by the rivers, especially during the dry seasons of the year, cannot fail to notice at the numerous rapids and low cataracts which interrupt his voyages the rocks underlying the prevailing covering. He recognises that the rock most usually exposed is gneiss, in varieties from massive, almost granitic in texture, to finely laminated, and that in places this is intersected by belts of granite; and that both are traversed by dykes of basic rocks which often are of diabase. He notices that where these dykes are numerous or extensive the neighbouring districts are traversed by ranges of hills, or the general plain is dotted with hills the surfaces of which are covered with ironstone gravel. And in these observations lies the key to the true history of the soils and earths of the forest region.

The Sandstones and the Diabase Intrusions.—Large areas of the interior of the colony are occupied by a thick stratified formation of sandstone and conglomerate. Just as the basal igneous rocks are so is this pierced and traversed by dykes of diabase, hence the latter rock must be of later origin than all except the sedentary coverings and the fluvio-marine deposits. The blue-grey rock varies much in depth of colour and in texture, and its varieties will be described in the chapters dealing with the petrography of the colony.

The diabase intrusions occur in belts, generally stretching across the colony in a north-westerly and south-easterly direction. The intrusions vary from narrow dykes, only exposed in the courses of the rivers during very dry seasons, some being not more than from two to three feet across, to low hills and to mountain ranges, some of which—for example, the Eagle mountains in the Potaro gold district—exceed in height two thousand feet. The tops and sides of the hills and mountains, except where they have suffered great denudation, are covered with ironstone gravel, while the lower parts of the districts in which diabase forms the

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Plate 6.

GOLD DIGGERS' CAMP

ON THE MINNEHAHA CREEK BELOW EAGLE MOUNTAIN,

KONAWARUK DISTRICT.

Photo by C. W. Anderson

country are covered up with strata of laterite, frequently over one hundred feet in depth, and in places interspersed with nests of secondary quartz, or traversed by veins and stringers of quartz, or, less often, by lenticular layers of secondary quartz, closely resembling, when cut through by mining shafts, tunnels and trenches, true quartz-reefs. The quartz rock in all these forms is not unfrequently auriferous, the metal being dispersed through it in a very irregular manner, especially in the larger lenticular layers, which in many parts are nearly, or even entirely, barren of gold, and in others are "bonanzas" carrying at rates from twenty to, in places, several hundreds of ounces of the precious metal to the ton of the rock. Unfortunately hitherto these bonanzas have proved few and far between; but there is no reason for assuming that they will not be found in many places in the enormous area of the laterite deposits which up to the present has not been prospected, as they have been in similar places at intervals in the past. Gold also occurs as paint gold, as gold dust, and as nuggets of very varying sizes in the laterite.

Of earlier age than the diabase is the sandstone and conglomerate series. It constitutes the greater portion of the Pacaraima mountains, and spreads westwardly into Venezuela. A similar formation occurs in Brazil, and in all probability is part of the same massif as the Guiana one. Wherever it occurs it appears to be unfossiliferous, and hence we have no palæontological evidence with regard to the geological period at which it was deposited. Two conjectures have been made as to this. C. B. Brown arrived at the conclusion, on what appears to me to be somewhat defective evidence (its, in parts, reddish colour, its unfossiliferous nature, and its being penetrated by masses, dykes and sills of greenstone—diabase—as are sandstones of Triassic age in North America), that it is an equivalent of the New Red sandstone. In Venezuela its relationship to rocks of known age is said to be recognisable, and it is stated to be of Cretaceous age. A like conclusion that the northern parts of the formation are of Cretaceous age has been arrived at in Brazil. If these views are correct, the later outbreaks of diabase, which are, directly or indirectly, the causation of many of the auriferous deposits of British Guiana, must be either of Cretaceous age, or belong to the Tertiary or to a later period. And as there is a very great resemblance in the magmatic character of the Guianan diabase, and of the lavas of the West Indian province, whose outbreaks are clearly of Tertiary and of present age, the assumption of the relatively recent age of the diabase is a plausible one. As will be mentioned in a later chapter, the diabase shows no signs of the effects of the regional metamorphism which has materially affected many of the rocks underlying the sandstone formation.

The only evidence available in this colony with regard to the sandstone and the geological period of its formation is that wherever its base has been seen it occupies an analogous position to the Torridonian sandstones of the Scottish Highlands, to which the sandstone has a close resemblance in constitution. It lies invariably on the presumably Archean rocks of the colony; and its constituents, as far as I have been able to examine them, show no signs of having, even in part, been derived from later rocks. If it is of Cretaceous age it offers an interesting example of the recurrence of similiar formations in widely divided geological ages, when the conditions affecting their formation and deposition are identical. Personally I am not prepared from my own observations and studies to accept any statements of its geological age further than that shown by its relationship to the underlying gneiss, porphyries, felstones and schists derived from them.

The sandstone formation spreads eastwardly through the Colony, crosses the Essequibo River in a low narrow belt at Comuti Mountain, gives rise to the Maccari Mountain in Demerara, and, crossing the Berbice River near Marlissa Rapids, is seen forming a low mountain range at Itabru near that river. It passes into Dutch Guiana across the Courantyne River near its union with the Cabelebo River, and also in its higher reaches. The formation consists of beds of coarse conglomerate, red and white sandstones of very varying texture, and in places of strata of red shale.

High mountains occur in the sandstone formation, which consist of coarse-textured diabase or of rather fine-grained gabbro. This rock shows signs of metamorphism, in places being granulitic in structure and in others being changed to a considerable extent, either by the development in it from augite of a dark-brown secondary biotite, or the pyroxene is altered from an almost colourless mineral to a brown-coloured strongly dichroic one.

Mr. C. Wilgress Anderson, who in 1895 spent several months in traversing the sandstone district while inquiring into the alleged occurrence of beds of auriferous conglomerate in it, and has since crossed it repeatedly during the Boundary Surveys, is of opinion that the diabase-gabbro is of greater age than the sandstone, the latter formation in places resting on or abutting against it, and this view is upheld by its structure. The hills were probably small islands in the shallow seas in which the sandstone formation was laid down. C. B. Brown, on page 14 of the "Reports on the Geology of British Guiana," mentions the occurrence of great layers of conglomerate in the neighbourhood of "greenstone," and this is confirmatory of Mr. Anderson's view. The possible existence of "greenstone" of two distinct geological ages and modes of occurrence does not seem to have struck Brown and Sawkins, but it offers an intelligible explanation of the facts recorded by them in their reports. These surveyors estimated the total thickness of the sandstone on the assumption that it is traversed by three layers of greenstone at about three thousand feet. As, however, it is probable that some at least of the latter diabase, as, for instance, that at Roraima, is in the form of laccolites, and during intrusion has elevated great tracts of the sandstone country, probably the formation has not the total thickness deducible from C. B. Brown's figures, and may at present not anywhere exceed in thickness that shown at Roraima—about two thousand feet. As a rule the sandstone lies nearly horizontally, dipping somewhat to the north, and few faults are seen in it although in places near where diabase has intruded into it

PLATE 7.

AMATUK FALL

AND MOUNTAINS AT THE ENTRANCE OF THE

KAIETEUR GORGE, POTARO RIVER.

Photo by C. W. Anderson.

there are well-marked local disturbances in its dip. Many of the beds of sandstone of finer texture show well-marked current-bedding.

Granite.—True granite with abundant orthoclase and both white and black mica does not appear to be an abundant rock in British Guiana. The largest development of it as far as I have been able to ascertain is the great mass extending from Makauria Point on the Essequibo to the south end of Karia Island on the Mazaruni, and to the foot of Akaio Rapid on the Cuyuni. Similiar granites, but of somewhat gneissose structure, also occur at Granite Island and at Canayaballi on the Waini River, and on the Pomeroon River. There is also an exposure of a granite on the Curiebrong River. These granites appear to be the youngest of the basal igneous rocks of the colony, and from Brown's observations at Akalikatabo Island, in the Courantyne River, may be in parts of more recent origin than the sandstone formation. As far as I have examined specimens of it the granite always shows either macroscopically or microscopically signs of mechanical stress and of incipient metamorphism, although this is but little marked in parts of the great Essequibo-Cuyuni-Mazaruni mass.

Belts of granite with only black mica, which may be in part replaced by hornblende, and with relatively abundant plagioclase-feldspar, are of fairly common occurrence in the colony, traversing the porphyry and felsite rocks, the various schists, and the gneiss. The rocks of these belts are granitites, but parts of the great Mazaruni granite mass above mentioned pass by imperceptible modifications into biotite-bearing rocks of this class. As a rule the effects of dynamic metamorphism are more marked in the granitites than in the granites, and many of the belts traversing the country are clearly seen to be gneissose granitites.

From the masses of granite and of granitite many dykes, veins and tongues of aplite, of muscovite-granite, and of micro-granite penetrate and intersect the adjacent rocks. The belts of granitic rocks, being more resistant to weathering than are the porphyries, schists and gneisses, usually give rise to low hill ranges or to isolated rounded hills, and where rivers have cut their courses across their belts the occurrence of the granitic rocks is usually marked by the presence of rapids or of low cataracts. In addition to the granites and granitites, hornblende-granite or quartz-diorite is not of unfrequent occurrence. In places augite is the principal ferro-magnesian mineral present, the rock becoming an augite-granitite; in others, though rarely, hornblende-granite passes into a true syenite, while true diorite seems to be a rock of rare occurrence in the district. Bands of augite-syenite also occur in a few places in British Guiana.

Quartz-porphyries, Porphyrites, Felsites, Porphyroids, and Sericite-schists.—Large areas of the colony are occupied by rocks belonging to this group, the massive members of which gradually and almost imperceptibly pass into the foliated schistose ones, and it is not possible in many places to demarcate one variety from the other.

Both field and laboratory studies indicate that the foliation is due to the operation of dynamic metamorphism. As a general rule these rocks yield comparatively easily to weathering agencies, and the lower parts of the colony occupied by them consist of level plains or of somewhat undulating land. The schistose members of the group in places show a fissile or a slaty structure and then weather into upstanding slabs. The finer-textured of the massive varieties are often of great hardness and tenacity, and where belts of rock of this description are crossed by the courses of the rivers, rapids and low cataracts occur; and in these the rocks are angular and rugged—in very marked contrast to the rounded masses which characterise rapids and cataracts caused by the rivers crossing belts of granite or bands of granitoidal gneiss. In the elevated parts of the colony in which rocks of this group are found the surface of the country is often extremely rough, and consists of rugged ridges and mountains, with tabular masses, and in places with jagged pinacles, of rocks protruding from the earth, and there forms a rough grass-covered country interspersed with patches of forest. Over the surface of the country frequent patches of blocks of the country rock are found, as are others of angular blocks of quartz, and of pebbles derived from the veins of quartz which are common in the altered members of the group. In some parts the quartz-porphyry or the felsite has been completely altered and converted into quartz-rock, this in places occurring as bands of quartz-schist. The finer-grained members of these silicified rocks locally are termed "jasper." The most commonly occurring rocks of this series are greyish-green in colour, but their colours vary from different shades of yellow to various ones of grey, green, brown, and black, while some are of shades of red ranging from pale dull red or brownish-red to very bright red.

The more basic members of this group of rocks are in parts much metamorphosed, giving rise to chloritic or actinolitic rocks frequently of complex composition and confused structure. These are usually of various shades of green, and generally possess a dull earthy appearance. In places chloritic rocks occur, which are of fine texture and have a marked fissile structure; and these may be metamorphosed stratified sedimentary rocks, or volcanic tuffs. Where weathering is at all advanced it is only by careful study in field and laboratory that their nature can be made out. Closely connected with the rocks of this group are felsitic mudstones and tuffs, which form in places layers in or below the basal beds of the sandstone formation, but these are of very subordinate importance in the lower lying parts of the colony.

The Gneissose Rocks.—Closely allied to the last-described rocks are those forming the basal rocks of the colony; it is, in fact, possible that the quartz-porphyries and their allies are properly parts of the formation now to be described, and are merely a phase in the earliest geological history of the colony. My investigations in the geology of the colony have led me to the opinion that the porphyries and their allies form a distinct phase in its earliest geological history, and represent a series of acidic lavas, either surface or deeper-seated, the outflow of which over wide areas of the Guianas characterised a period subsequent to the formation of the basal gneiss; outflows which the occurrence in places of tuffs and felsitic muds indicates may not have terminated at the commencement of the sandstone and conglomerate period. Hence chronologically I regard the basal gneisses as older than the porphyries and the schists derived from them; although in places schists belonging to the porphyry series appear to be intercalated with some of the more highly foliated members of the gneiss.

Among the gneisses I include the epidiorites and hornblende-schists, the almost massive quartz-diorites, the amphibolites, and the more or less altered diabase-gabbros which are found in intimate relationship with the acidic rocks which make up the mass of the fundamental gneiss. These would appear to represent the basic rocks—probably gabbros,—of the complex which gave rise by its metamorphism to the fundamental gneiss of the Guiana region.

The intensity of the dynamic metamorphism to which the original rocks were subjected having varied greatly, the degree of schistosity in the gneisses differs widely, and in sympathy with this so do the effects of weathering upon them and the character of the country in which they occur.

The rocks of this class vary in a gradual, and often in an almost imperceptible manner, from massive, almost granitic, rocks which offer little evidence of foliation, at times so slight as not to be noticeable in hand specimens, although more or less readily distinguishable in the field where the rocks are seen *en masse*, through others showing roughly marked apparent beddings, caused by some parallelism in the arrangement of their component minerals, to true gneiss showing well-marked foliation.

The constituents of the true gneiss are arranged in narrow more or less parallel layers, which in places are so much bent, curved and contorted as to assume the damascened appearance like to that sometimes noticeable on sword-blades or on gun-barrels; whilst, although as far as my experience goes but rarely, in places the dark ferro-magnesian minerals are in curved folia streaming around unaltered kernels of the acidic minerals. In places the laminæ are very thin, either parallel in their relationship one to another, or very minutely crumpled, and the rocks show the characteristics of crystalline schists. This schistose structure is far more common in the basic layers of the banded varieties of the gneiss than in the acidic ones, although instances of it occur in the latter. It also characterises some of the belts of hornblendic rocks which traverse the gneissose country.

A study of the gneiss, both *in situ* and in hand specimens and in thin sections, shows that the gneiss has undoubtedly been derived from granitoid rocks, varying in their nature from aplite through granitite and quartz-diorite to basic rocks probably of a gabbro or diabase-gabbro type, by the action of dynamo-metamorphism, the degree of the mechanical and molecular alterations which they now exhibit being proportionate to the intensity of the strains and other forces to which they were exposed during their deformation by earth-stresses.

The commonest variety of the gneiss is a grey or pinkish-grey granitite-gneiss which in places changes into a white or light pink aplite-gneiss, and in others to a darker-coloured hornblende-granitite gneiss, and occasionally to dark-grey or greenish-grey quartz-diorite-gneiss, or to still darker-coloured diorite-gneiss. The grantitite-gneiss in common with the other varieties of gneiss, but perhaps more frequently, is traversed by veins of aplite and of very coarsely crystalline pegmatite. In many places veins of pegmatite by gradual decrease of feldspar and increase of quartz, pass gradually and almost imperceptibly into quartz-veins. As far as I have examined them, quartz-veins of this character do not contain gold in payable quantities.

In places, usually near intrusions of granite, the gneiss has undergone marked alteration, the ferro-magnesian minerals being collected together and forming great masses of a basic biotite-gneiss, or more often of hornblende-biotite-gneiss. These highly basic masses alternate with others of aplite-gneiss which frequently contain thin veins and small nests of green epidote. In a few places the banded varieties of gneiss contain layers of finely foliated green-coloured epidote-hornblende-schist.

Although the massive varieties of gneiss pass almost imperceptibly into the more foliated kinds, this is not noticeable at times when the waters in the rivers are high. Then the only rocks seen belonging to this series through long stretches of the rivers appear to be, unless very carefully examined, massive granites; and this doubtless led Brown and Sawkins to give somewhat undue prominence to the granite rocks of the colony in, at any rate, the more northerly parts of their geological map.

There is a well-marked difference in the weathering and the degradation of the foliated and the more massive varieties of the gneiss. The former yield readily to atmospheric influences, and to the effects of the great differences in their temperature during the day, when in the dry seasons they are exposed to the rays of the sun, and during the night. They either split into small slabs and flat pebbles where the rocks are usually covered by the waters of the rivers, and only in the driest parts of the year are exposed to the sun in the daytime and to rapid radiation of their heat during the nights, or, where they are more constantly exposed to these influences, they undergo degradation to white, grey, or cream-coloured, or ochreous sandy clays; which, in the parts which are below the usual level of the river, or are otherwise protected from the action of the atmosphere and of that of percolating water, may retain the foliated structure of the original rocks, the positions of the more basic portions being indicated by lines and nests of rusty-looking ochre. The more massive kinds are far more resistant to weathering, and remain as great rounded masses standing out from the surfaces of the foliated varieties, or as rounded rocks where the main mass of gneiss has been degraded into argillaceous products. Where bands of the massive sorts occur the country is traversed by low rolling ridges, while the foliated varieties of the acidic gneiss give rise to relatively low-lying plains. But the more basic members, such as the hornblende-schists, epidiorites and amphibolites, usually project from the gneissose plains, and give rise to elevations varying from low knobs to ranges of hills which, as, for example, the Blue Mountains in the lower Essequibo district, may attain to heights of several hundred feet.

The strike of the foliation of the gneiss varies greatly in direction, and in the districts I have visited its trend varies in all directions even over comparatively small areas—it may be, in places, north and south, whilst it may be in others in the near vicinity east and west.

This complexity of foliation—due probably to recurrent earth-stresses acting in different directions and with varying intensities—was noticed and recorded by C. B. Brown.

The general geological structure of the colony in the districts not covered by the sandstone formation resembles to a marked degree that of the north-eastern seaboard of North America, and of the Brazilian seaboard of South America, north of Rio Janeiro.

CHAPTER VI.

THE PETROGRAPHY OF THE FUNDAMENTAL GNEISSOSE COMPLEX.

THE fundamental gneissose complex of British Guiana resembles to a marked extent the Archean-gneiss of other parts of the world. It is divisible into rocks of two ages—the older gneiss usually acidic, but having in places basic beds almost inseparably intercalated with it, and the later basic intrusives now represented by an extensive series of epidiorites, amphibolites and hornblende-schists.

Excellent sections of the gneiss from which characteristic specimens can be obtained are exposed at many of the cataracts and rapids in the courses of the rivers, especially at those in the lower parts of the Mazaruni River, below and east of Teboco Cataracts. As a rule, however, the country consisting of gneiss is relatively flat and low-lying, whilst the rock is changed to sandy clays for great depths. Where the rivers traverse country of this sort the gneiss is usually only seen when the beds of the rivers are exposed during the extremely dry seasons. The course of the Essequibo River between Gluck Island and Kuratoka Falls is through gneissose country, and exhibits the above characters to a marked extent.

The Gneiss.—The prevalence of gneissose rocks over a large area of British Guiana has been already pointed out. The commonest variety of gneiss is a granitite-gneiss with abundant oligoclase-feldspar, which in parts contain more or less hornblende, and thus passes through hornblende-granitite-gneiss to diorite-gneiss. The texture of the gneiss varies very greatly. It is usually somewhat finely foliated, the laminæ in places being highly contorted, whilst in others it possesses a banded structure, and occasionally the more perfectly foliated portions curve round unaltered pieces or eyes of the original rock. It is frequently traversed by veins of very coarsely crystalline pegmatite, the feldspar crystals of which are generally grey in colour, but are occasionally pink or red, and in places are from one to as much as six inches in length, whilst plates of dark mica (biotite) may attain diameters of from one to one and a half inches. The gneiss is also traversed by veins of fine-grained granite and of aplite, apophyses from the intrusive masses of granite and granitite which occur in places amid it. The rock varies in a gradual and, in parts, almost imperceptible manner from a massive almost granitoidal one, which offers but little evidence of foliation, frequently not noticeable in the hand specimens, although more or less readily distinguishable in the field, to a true gneiss with more or less marked foliation, this showing that the gneiss has been derived from granitic rocks, and that the foliation is a result of their exposure to dynamic or regional metamorphism.

The most usual colour of the gneiss is light-grey, but in parts it not unfrequently has a pinkish tinge. In the banded varieties layers of white, greyish-white, or of pink aplite-gneiss or granulite alternate with layers of dark-coloured, to almost black, hornblende-granitite-gneiss or diorite-gneiss, or with greenish-grey ones of epidote-granitite-gneiss.

A large number of specimens of the different kinds of gneiss have been collected from various districts and examined. The following are descriptions of some of the more characteristic kinds :—

Aplite-gneiss.—This rock is of either a white or a pinkish colour, and usually is fine-grained, with in places some larger crystals of feldspar. It occurs in two forms—granitoidal and granulitic. Its specific gravity varies from 2·58 to 2·72. The rock is generally banded with hornblende-gneiss.

The granitoidal variety has been found at "Little Kamaria" Rapids, and at "Devil's Hole" in the Cuyuni River, at Kabowira Rapid on the Mazaruni River, and at Itaka on the Lower Essequibo River.

The rocks consist of granitic aggregates of quartz, in places showing strain-shadows, or being more less granulitic with orthoclase-feldspar in places in large plates, which occasionally show a microperthite structure, and often are more or less sericitised, irregularly bounded plates of clear microcline, plates of oligoclase and of albite, frequently with bent or broken lamellæ, and occasionally patches of vermicular micropegmatite ; some flakes of muscovite, both original and secondary, and small flakes of greenish biotite, are occasionally present ; minute granules of pyroxene, or plates of green hornblende occur, though seldom, and only in very small quantities as accessories ; granules of epidote, of sphene, of garnet and of magnetite may be present, while a few minute crystals of apatite are seen in places.

The granulitic varieties are made up of a micromosaic of quartz and water-clear feldspar, with here and there plates of oligoclase, with some scattered minute granules of epidote and some grains of magnetite.

GRANITITE-GNEISS.

This is the prevalent gneissose rock of the colony. It varies from a somewhat coarsely foliated, almost granitoidal, rock to a finely foliated, almost schistose one. According to the minute structure the granitite-gneiss may be classed as :—

1. Granitoidal.
2. Commencing Granulitic.
3. Granulitic.

The rock consists essentially of quartz, orthoclase, microcline, oligoclase and biotite. It varies in colour from light-grey to light-pink, but in places has a somewhat greenish tinge. The average specific gravity is 2·67, the extremes being 2·75 and 2·58, according to the proportions of biotite present.

The following are descriptions of typical specimens of the rock:—

1. *Granitoidal Variety.*—Specimens from Hellgate Falls on the Barima River; Yamatuk and Teboco on the Mazaruni River; from many places such as Pigeon Island, Rockstone and Moco-Moco on the Essequibo River; from the Pomeroon River; from Devil's Hole Cataracts on the Cuyuni River, and Wallaba on the Demerara River, consist of granitic aggregates of irregular patches of quartz, showing more or less well-marked strain-shadows, or much fractured; plates of orthoclase-feldspar, in places with a microperthitic structure, irregular patches of water-clear microcline, and plates of oligoclase, sometimes with the lamellæ bent or broken, with some of albite, in parts a little vermicular micropegmatite; some of the feldspar plates are crowded with minute flakes of sericite and prisms of epidote. In places sparse small flakes of muscovite occur, many flakes, wisps and nests of green and olive-green biotite, frequently more or less chloritised, are present; small plates of green hornblende occasionally occur; whilst as accessories small grains of garnet, of magnetite, of ilmenite and rarely of anatase, and minute crystals of apatite and zircon are found.

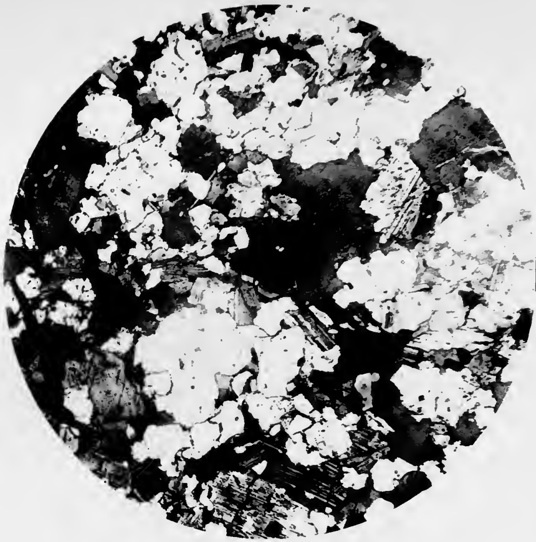
2. *Commencing Granulitic.*—The granitoidal gneiss changes gradually and almost imperceptibly into gneiss, the foliation of which in large masses is clearly seen, but which is not well-marked in hand specimens.

As a rule, its minute structure does not differ greatly from that of the granitoidal, but signs of dynamic metamorphism are more apparent. The feldspar plates frequently show strain shadows, and on their edges signs of becoming granulitic; the patches of quartz are broken, and are often granular, whilst where they are affected to a less extent they show well-marked strain-shadows. In parts the striæ of the plagioclase-feldspar are bent or broken, while the biotite-mica in places very markedly shows strain-effects.

The following is a general description of the structure of specimens from Polvo de Oro in the Amacura River; Carriage Falls in the Barima River; Kapasi Channel, Kabowira Cataracts, above Turesi Cataracts and Kartauari Rapids in the Mazaruni River; Taparoo in the Puruni; from Souarindo in the Pomeroon River; from Saxacalli Point and Great Yukuribi Rapids in the Essequibo, from Tiger Creek Falls and Eagle Mountain in the Potaro district, and from Arimu Creek and from above Mopay Rapids in the Cuyuni River. The rocks are granitic aggregates of irregular patches of quartz, more or less granulitic, in places showing well-marked strain-shadows; plates of orthoclase-feldspar occasionally showing strain-shadows and frequently crowded with sericite and epidote, in places the plates show the structure of microperthite; some patches of water-clear microline, relatively abundant plates of oligoclase and some of albite, the lamellæ of which are frequently bent or broken, whilst micropegmatite is of somewhat rare occurrence. In places a few small

[To face page 32.

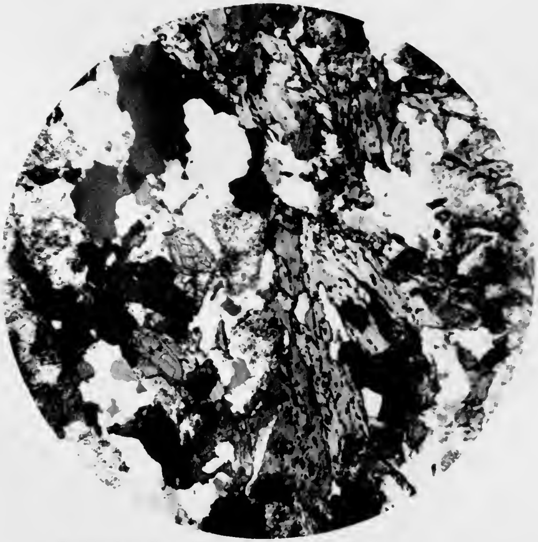
I.—i.



GRANITITE GNEISS, × 12,
KAPASI, MAZARUNI RIVER.

Photo by J. Williams.

ii.



HORNBLENDE GRANITITE GNEISS, × 30,
ITAKI, MAZARUNI RIVER.

Photo by J. Williams.

plates of muscovite are present; laths of olive-green biotite are in parts irregularly scattered through the rock, and in others they form streams; much of the biotite is more or less chloritised, and in places is completely changed into chlorite; in a few specimens sparse granules of pyroxene are present, while in some others pale-green hornblende is found in small quantity; occasionally epidote is present, apparently in original crystals, but more commonly as secondary granules. Grains of sphene, of garnet, of magnetite and of ilmenite, with, in places, leucoxene, minute crystals of apatite, of zircon, and rarely of rutile, form unimportant accessories.

3. *Granulitic.*—Parts of the gneiss where the dynamic forces have been more intense show not only a well-marked foliated structure but the quartz and feldspar are granular. Specimens of this have been obtained from north of Flat Rock in the Barima River; Takkari Rapids, Wariri, near Quartz Stone, and in the Arimu Creek in the Cuyuni River; Itaballi Rapids and near Teboco in the Mazaruni River; and from Great Saya Falls in the Essequibo.

These rocks are mainly composed of a confused aggregate of granular and granulitic feldspar and quartz; most of the feldspar granules are water-clear and not striated, but some show the characteristics of microcline and others those of oligoclase, or in places of albite; in parts a few large plates of orthoclase are present, and are more or less sericitised. Rarely a few flakes of muscovite are noticeable, greenish biotite is present, either as scattered small scales or in streams, whilst small plates and patches of green hornblende are of rare occurrence. As accessories in unimportant quantities grains of epidote, magnetite, sphene and apatite occur.

Hornblende-granitite-gneiss.—There is usually a well-marked distinction between the granitite-gneiss and the hornblende-granitite-gneiss. Although in the former class some specimens have been found containing a few sparsely distributed small plates of green hornblende I have found few that can be considered as on the border between the two classes. The gneiss in the parts of the colony which I have traversed is usually either well-marked granitite-gneiss or equally well-marked hornblende-granitite-gneiss.

The hornblende-granitite-gneiss is frequently granitoidal in structure and coarse in texture. It is usually of a reddish tinge, but in places has a greenish hue. The biotite and hornblende are generally conspicuous on freshly fractured surfaces. The specific gravity varies from 2·69 to 2·85, but that of by far the greater majority of the specimens collected falls between 2·74 and 2·76. The mean specific gravity is 2·75.

The granitoidal varieties are well seen at Devil's Hole Cataracts in the Cuyuni River, on the Mazaruni River at Kartauari, near Turesi, and in Teboco Channel; at Taparoo and at Long Falls on the Puruni River; at Moneri Island and at Moco-Moco on the Essequibo River; and below the Great Fall or Ororu Marali on the Demerara River. The rocks are made up of granitic aggregates of irregular areas of quartz showing strain-shadows, or in places broken and showing signs of becoming granulitic; large clouded plates of orthoclase-feldspar, some of which show the structure of microperthite, abundant patches of water-clear microcline, and many of oligoclase, in a few places with abundant minute crystals of epidote and flakes of sericite included in them, with some small patches of albite and some vermicular micropegmatite. Small flakes of muscovite are of rare occurrence; plates of dark-green biotite, which in places are more or less chloritised or completely changed to green chlorite, are present in varying quantity, frequently forming aggregates with flakes and patches of green hornblende (some of the plates of the latter contain extruded grains of magnetite); the aggregates of biotite and hornblende are in places accompanied by apparently original crystals of epidote; small grains of augite are present but rarely; epidote is present in small quantity as aggregates and in irregular grains. Sphene is of rather common occurrence in small crystals and in granules, whilst grains of magnetite, of ilmenite and garnet, and minute crystals of apatite, zoisite and zircon are unimportant accessories; in places strain-phenomena are noticeable in the feldspar plates and in those of biotite as well as in the quartz.

At Matope Cataracts, at Takkari Rapids, and at Devil's Hole in the Cuyuni River; at Itaki Rapids in the Mazaruni River; at Stop Falls in the Puruni River; at the Kuribrong Falls in the Potaro District; and in the Groete Creek of the lower Essequibo River hornblende-granitite-gneiss is present, in which the foliation is fairly well-marked. As a rule the ferro-magnesian minerals are present in somewhat greater abundance in those than in the granitoidal varieties, and the fissile structure is due to parallelism in their arrangement. The rocks are composed of irregular areas of granular quartz, the larger fragments of which in places show strain-shadows; plates of orthoclase usually clouded with minute flakes of sericite and of epidote, and in a few specimens small irregular patches of microcline, many plates of oligoclase in places crowded with minute crystals of epidote, and having their lamellæ not infrequently bent or broken. Some of the feldspar-plates are in parts converted into a quartz-feldspar micromosaic, and, generally speaking, the effects of dynamic metamorphism are very noticeable in the feldspar of this class of gneiss. Abundant plates of olive-green and of green hornblende are found which in places are bent or broken or contain extruded grains of magnetite; in parts, but rarely, plates of colourless augite are present in small quantity; dark brownish-green or green biotite is present either as plates, frequently bent and showing well-marked strain-effects, scattered through the rock or forming streams encircling eyes of feldspar; the biotite is in places more or less chloritised or completely altered into chlorite. Small plates and grains of epidote, grains of magnetite and of sphene and minute crystals of apatite and of zircon form unimportant accessories. The rocks are in places traversed by many thin veins of epidote with some calcite.

Occasionally the hornblende-granitite-gneiss approaches in structure to a schist. Specimens of this variety have been obtained from Juanita

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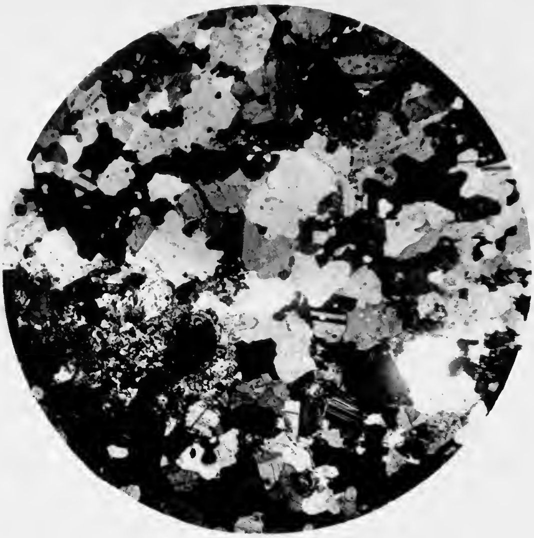
II.—i.



EPIDOTE GRANITITE GNEISS, × 12,
TIKURU, ESSEQUIBO RIVER.

Photo by J. Williams.

ii.

DIORITE GNEISS, × 30,
TUPEKU, MAZARUNI RIVER.

Photo by J. Williams.

on the Amucura River, Wanaparn on the Barima River, Arimu Creek in the Cuyuni River, Parawakas Rapids on the Mazaruni and at Itaka on the Lower Essequibo. These have the following structures:—

The rock is made up of a micromosaic of quartz and feldspar, some of the granules of the latter showing the characteristics of microcline and others of oligoclase; whilst in places a few scattered small plates of muscovite are present. Streams of more or less elongated plates of pale bluish-green hornblende traverse the rock, and are accompanied by wisps of biotite usually more or less chloritised; rarely a few granules of augite are present; some granular epidote is a common accompaniment of the hornblende; small grains of sphene, and of melanite and rarely minute crystals of apatite form accessories.

Epidote-granite-gneiss.—A noticeable feature in several of the specimens of the gneiss is the occurrence of epidote in the form of small prisms in some of the feldspars, and also as small plates surrounded by hornblende or biotite, in such a manner as to indicate that the mineral is an original product of the solidification of the magma. The epidote-granitite-gneiss is usually either grey or greenish-grey in colour, and varies from almost granitoidal rocks to others more or less well-foliated. The specific gravity of this variety of gneiss varies from 2·70 to 2·86, the mean being 2·78.

Gneiss containing small prisms of epidote in the feldspars occurs at the Kuribrong Falls in the Potaro district, near Turesi and Kartauari in the Mazaruni River, and in the Arimu Creek of the Cuyuni River; and has the following general composition:—

A granitic aggregate of irregular areas of granulitic quartz; plates of orthoclase-feldspar in places clouded with films of sericite, and larger ones of oligoclase crowded with minute crystals of epidote and of zoisite, the lamellæ of the feldspar plates being frequently bent or broken. A few small flakes of muscovite, and more abundant plates of greenish biotite, more or less chloritised, or in parts completely changed into chlorite are found. In places some granules of colourless augite occur, and some small plates of green hornblende, which, in places, is more or less chloritised, whilst small granules of secondary epidote are scattered through the altered hornblende more or less abundantly. Small grains of magnetite and of sphene, and some minute crystals of zircon are present. The rock is in places traversed by thin veins of aggregates of epidote and chlorite.

The variety containing small plates and crystals of epidote surrounded by biotite or hornblende occurs at the Towakaima Creek and Falls on the Barama River; on the lower part of the Kamaria road on the Cuyuni River; near Turesi, Kartauari, and south of Tupeku on the Mazaruni River; and in the Black Creek, a tributary of the Groete Creek, in the Lower Essequibo district. This variety consists of a granitic aggregate of irregular areas of quartz showing strain-shadows; plates of orthoclase-feldspar in places with abundant inclusions of small crystals of muscovite, but more usually clouded by minute inclusions of sericite and of epidote, a few irregular patches of clear microcline, relatively large plates of oligoclase having their lamellæ more or less bent or broken, with in a few places a little vermicular micropegmatite; fairly abundant plates and nests of flakes of brown to greenish-brown biotite, frequently more or less chloritised, and with small plates of apparently original epidote, aggregates of chlorite after biotite, epidote, and sphene with some grains of magnetite. In places, a few irregularly broken pieces of colourless augite with some green hornblende occur. Small crystals, grains, and granular aggregates of sphene are of somewhat frequent occurrence; whilst a few scattered grains of magnetite, a few minute prisms of apatite, and minute crystals of pyrites form unimportant accessories.

At the Upper Mariwa Cataracts, in the Cuyuni River, at Puruari Creek in the Puruni River, and at Tipuri Point in the Essequibo River, gneiss is found containing granular epidote in considerable abundance. In these rocks the feldspar and quartz are present in clear granulitic mosaics, and in the rock from the latter place granules of melanite (black garnet) are present in abundance. The epidote in them is probably of secondary origin.

Granitite-gneiss altered by dykes of Basic Rocks.—Where traversed by large dykes and masses of diabase, the gneiss in some cases appears little affected, whilst in others it has undergone more or less marked changes. For instance, the great belt of diabase which gives rise to the Falls of Oruro Malali on the Demerara River, traverses a country of coarse-textured hornblende-granitite gneiss. The effects of the intrusive mass are distinctly noticeable on the gneiss at about fifty yards from the contact of the rocks, and become very marked upon approaching it. The gneiss gradually assumes a granitoidal character, the foliation becoming obliterated. Close to its contact with the diabase its appearance resembles that of a porphyrite with crystals of orthoclase and oligoclase with rounded outlines lying in a dark-coloured base. Under the microscope the rock does not show any marked signs of alteration in the feldspars, although these are more or less clouded, but the hornblende-plates have been changed to clouded aggregates of minute specks of augite, with some epidite and zoisite and with small extruded grains of magnetite, whilst the plates of brown biotites are less altered, although they generally contain many extruded grains of magnetite.

The great dykes of diabase which give rise to the Tinamu and Paiyuka Cataracts of the Cuyuni River, produced during their intrusion into the granitic-gneiss of the district more marked changes than resulted at Oruro-Malali. The gneissose structure of the country is in the vicinity of the dykes obscured or almost obliterated. Where most altered the rock resembles a granite containing small white areas of quartz with abundant dark grey to almost black crystals of feldspar. Near the dykes the biotite originally present in the gneiss is changed completely into areas of minute grains and dust of magnetite with a little augite scattered through them. Farther from th contact

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III.—i.

BIOTITE SCHIST, × 30,
MABURIMA, ARUKA RIVER.

Photo by J. Williams.

ii.

EPIDIORITE, × 30,
TURESI, MAZARUNI RIVER
(*See* PAGE 44).

Photo by J. Williams.

some of the original biotite remains only partially changed to magnetite and augite. The feldspar crystals for a considerable distance from the contact have been darkened owing to the developments of very minute specks and glassy intrusions, and especially to the production of innumerable exceedingly minute gas-bubbles throughout their mass.

Diorite-gneiss.—In many places the granitite-gneiss has intercalated with it bands of a basic gneiss apparently derived from crushed diorite, diabase or gabbro. These are dark-coloured, usually somewhat fine-grained rocks, approaching in general characters to hornblende-schist. Their specific gravities vary from 2·85 to 3·00, the mean being 2·91. Rocks of this class have been obtained from the Towakaima Falls in the Barama River, from Arimu Creek and from Devil's Hole on the Cuyuni River, from Tupeku, Itaballi Rapids, and the Teboco channel of the Mazaruni River; from Wolga, Abouia-Malali and Ararapira on the Essequibo River; and from near the Sandhills on the Demerara River. They are divisible into two classes, one having a granitoidal structure and the other a foliated one.

The granitoidal rocks are made up of granitic aggregate of large plates of pale blue or of green hornblende with many crystals of brown biotite, the latter in places being secondary to the former; some plates and abundant granules of epidote; plates of orthoclase-feldspar clouded with sericite, some of clear microcline, and patches and plates of plagioclase and of a water-clear feldspar; some small irregular areas of quartz; some grains of sphene, and a few prisms of zoisite; whilst small crystals of apatite are present in very varying quantity.

The foliated varieties have a very close resemblance to hornblende-schists and are composed of allotriomorphic granules, and in places of idiomorphic lath-shaped plates of green hornblende, some of which are poikilitic; and flakes of greenish biotite usually more or less chloritised, lying in a granular mosaic of water-clear and of plagioclastic feldspars, some granules of which contain minute flakes of sericite and grains of epidote, with some quartz; a few grains and aggregates of epidote, a few minute prisms of zoisite, and of apatite with some zircon, and a few minute grains of magnetite are unimportant accessories.

Biotite-schist.—In a few places the gneiss contains very abundant flakes of biotite and passes into biotite-schist. Examples of this have been obtained from Matope Cataracts, Arimu Creek, and Devil's Hole in the Cuyuni River; from Tupeku in the Mazaruni River, and from Tiger Creek in the Puruni River. The rocks are made up of a granulitic mosaic of water-clear and of plagioclastic feldspar and quartz with some larger plates of orthoclase, which is traversed by numerous streams of long and narrow wisps of dark-brown biotite arranged with their long diameters approximately parallel, with some flakes of muscovite and in places with a few small plates of green hornblende and in others with some lath-shaped crystals of epidote and zoisite; in parts some patches of chlorite occur; grains of anatase, of garnet, and of magnetite, with some minute prisms of apatite form unimportant accessories. The country rock of the Aruka in the North-Western district is a gneiss which, near to the masses of epidiorite and hornblende-schist traversing it, has the character of a granitite passing into a biotite-schist. These varieties differ only in the arrangement of the biotite; in the granitite it is in irregularly scattered small brown plates of varying shapes, while in the schist it forms lath-shaped crystals arranged in the rock in streams parallel to their long diameters. The mass of these rocks is a mosaic of water-clear plagioclase-feldspar with quartz, some sparse plates of muscovite, a few irregular grains of epidote, scarce grains of pyrite, and some minute prisms of apatite.

The lower rapids in the Waini River are over a dark-grey, highly contorted mica-schist traversed by narrow veins of muscovite-granite. The mica-schist is made up of very numerous elongated prisms of dark brown biotite with some of muscovite arranged in curving more or less parallel streams traversing a rather coarse-textured granulitic mosaic of quartz with some water-clear feldspar. A few small granules of garnet and some minute grains of zircon in the biotite form unimportant accessories.

The specific gravity of the biotite-schists varies greatly according to the proportion of biotite present, the range being from 2·63 to 2·95.

Muscovite-schist.—This appears to be of rare occurrence. I have found specimens in two localities only—in the Black Creek, a tributary of the Groete Creek, and near Teboco in the Mazaruni River. The former is a white glistening rock having a specific gravity of 2·65, and consists of a granulitic mosaic of water-clear feldspar, some granules of which show the striæ of plagioclase, and quartz; with abundant plates, varying greatly in size, of muscovite. The latter rock is similar in appearance but grey in colour, and its specific gravity is 2·62. It is made up of a mosaic of granules of quartz with granules of much altered and sericitised feldspar, in which are many laths of muscovite, some ghosts of flakes of biotite, and relatively abundant minute grains of magnetite. In some parts of this rock the quartz is in patches which are much fractured but are not granulitic.

Pyroxene-gneiss.—Foliated rocks containing as their principal ferro-magnesian constituents either augite or other pyroxene are of very rare occurrence in the districts I have visited. The only place where I have found a pyroxene-gneiss is at Haiowa Rapids on the Essequibo River. It is a fairly compact, well-foliated, dark-coloured, rock, of specific gravity 2·92, and consists of allotriomorphic granules of colourless augite and some of enstatite in a mosaic of grains of water-clear plagioclase-feldspar, with a few of quartz; it also contains a few plates of pale green hornblende, some granular epidote in places, and some grains of sphene and small prisms of zoisite.

Pegmatite.—The gneiss is traversed in places by very numerous veins of pegmatite. These are either made up of very large plates of oligoclase with some of orthoclase showing more or less well-marked microcline structure, some microperthite, and with quartz in large irregular patches, in places granulitic, included in the feldspar; in places broad plates of biotite, scarce small flakes of muscovite occur, and minute flakes of sericite are found in the feldspar; or they consist of large irregular plates of microcline with included patches of oligoclase or albite with curved laminæ and corroded outlines, and irregular patches of quartz; the feldspars being frequently cracked and the cracks filled with epidote. The pegmatites are therefore of two kinds, both of which contain irregular areas of quartz, but one consists essentially of plagioclase-feldspars with subordinate quantities of alkali-feldspar, the other of microcline with subordinate quantities of plagioclase-feldspar. The pegmatites frequently change from highly feldspathic veins to veins consisting almost entirely or entirely of quartz. In the feldspathic pegmatites crystals of feldspar are found in places from six to eight inches in length, while the biotite separates out in plates up to two or three inches in diameter. Garnets are of common occurrence in parts of the pegmatite-veins, and fair-sized crystals of beryl and of apatite are found in it in a few localities.

THE CHEMICAL AND MINERALOGICAL COMPOSITION OF THE GNEISS.

Chemical Composition.—Analyses have been made of the granitite-gneiss, of the hornblende-granitite-gneiss, and of the diorite-gneiss, using average bulk samples drawn in each case from several localities, with the following results :—

	Granitite-Gneiss.			
	North-Western District.	Cuyuni River.	Mazaruni River District.	Essequibo River District.
Silica	72·54	67·61	70·09	67·40
Alumina	16·19	14·54	15·12	19·06
Iron peroxide	1·16	1·13	1·72	0·71
Iron protoxide	1·17	3·44	1·13	1·31
Magnesium oxide	0·65	1·39	1·22	1·90
Calcium oxide	3·25	3·18	2·61	4·30
Sodium oxide	4·47	5·63	3·61	3·16
Potassium oxide	0·23	0·82	2·75	1·52
Water	0·05	1·48	0·78	0·30
Carbonic anhydride	nil.	0·06	trace.	0·32
Titanium oxide	0·20	0·72	0·67	0·34
Zirconium oxide	—	nil.	trace.	—
Phosphoric anhydride	0·12	0·09	0·11	0·015
Chlorine	—	0·02	0·02	—
Iron sulphide	trace.	nil.	0·02	0·004
Manganese oxide	trace.	0·16	0·08	0·06
Barium oxide	—	0·11	nil.	—
Copper oxide	—	nil.	0·04	trace.
	100·03	100·38	99·97	100·399

	Hornblende-granitite-gneiss. Cuyuni River.	Mazaruni River District.	Essequibo River District.	*Diorite-gneiss.* Mazaruni River District.
Silica	61·38	63·56	63·77	54·36
Alumina	15·24	11·72	19·13	14·27
Iron peroxide	3·31	4·90	1·66	6·28
Iron protoxide	3·43	1·10	1·15	3·04
Magnesium oxide	2·61	3·65	4·29	5·87
Calcium oxide	4·79	4·12	5·63	7·50
Sodium oxide	3·29	6·44	2·20	3·35
Potassium oxide	2·05	2·30	0·99	2·22
Water	2·38	0·81	0·60	1·21
Carbonic anhydride	0·02	0·79	0·14	trace
Titanium oxide	0·50	0·18	0·17	0·30
Zirconium oxide	trace	trace	—	trace
Phosphoric anhydride	0·70	trace	0·015	0·33
Chlorine	0·04	0·06	—	0·02
Iron sulphide	nil.	nil.	0·004	0·02
Cobalt oxide	nil.	0·08	nil.	nil.
Manganese oxide	0·10	0·24	0·20	1·19
Barium oxide	0·12	0·01	—	0·02
Copper oxide	trace	0·03	—	0·06
	99·96	99·99	99·949	100·04

Assays were made on large samples of these rocks, using from 8 to 16 assay-tons for each determination, and these showed that the granitite-gneiss from the North-Western district yielded gold in minute quantity, amounting to somewhat less than one-tenth of a grain to a ton of the rock, that of the Mazaruni district yielded gold at the rate of 9 grains to the ton, while that of the Essequibo district indicated only minute traces of the metal. The hornblende-granitite-gneiss of the Mazaruni district yielded gold upon assay at the rate of 1 grain per ton, and that of the Essequibo district had a contents at the rate of 23 grains, whilst the diorite-gneiss of the Mazaruni district yielded at the rate of 8 grains per ton.

The granitite-gneiss from the Cuyuni was obtained from the district between Tinamu and Payuka Cataracts and an average sample yielded at the rate of 85 grains of silver and 4 grains of gold per ton of the rock. Samples taken at the cataracts from near the contacts of the gneiss and the intrusive diabase yielded at the rate of 77 grains of silver and 17 grains of gold per ton of gneiss.

Hornblende-granitite-gneiss from the Mariwa Cataracts in the Cuyuni River yielded at the rate of 42 grains of silver and traces only of gold to the ton of the rock.

Mineral Composition.—The following minerals and aggregates of minerals have been recognised in the specimens of the gneiss which have been examined :—

1. Original.

Quartz, orthoclase, microcline, albite, oligoclase, labradorite, microperthite, muscovite, biotite, hornblende, epidote, augite, ilmenite, magnetite, sphene, garnet, zircon, anatase, spinel and apatite.

2. Secondary.

Sericite, epidote, zoisite, garnet, magnetite, hematite, limonite, chlorite, leucoxene, sphene, pyrite, serpentine and calcite.

The mineralogical compositions of the gneisses may be represented as follows :—

	Granitite-gneiss.			
	North-Western District.	Cuyuni River.	Mazaruni River District.	Essequibo River District.
Quartz	37·8	24·3	27·9	33·6
Corundum	3·1	—	—	3·4
Orthoclase	—	2·8	18·4	—
Oligoclase (Ab_2 An_1)	—	57·9	—	—
Andesine (Ab_3 An_2)	52·0	—	—	—
Andesine (Ab_4 An_3)	—	—	43·4	—
Labradorite (Ab_5 An_6)	—	—	—	43·9
Muscovite (Sericite)	—	—	—	7·7
Biotite	2·2	5·3	5·7	7·4
Hornblende	3·7	—	3·0	3·2
Chlorite	—	4·9	—	—
Magnetite	—	1·1	—	—
Ilmenite	—	1·4	—	—
Sphene	0·6	—	1·6	0·8
Apatite	0·3	0·2	0·3	—
Calcite	—	—	0·7	0·7
Minor constituents	0·3	2·1	—	—
	100·0	100·0	101·0	100·7

	Hornblende-granitite-gneiss.			*Diorite-gneiss.*
	Cuyuni River.	Mazaruni River District.	Essequibo River District.	Mazaruni River District.
Quartz	22·0	15·4	31·5	12·1
Corundum	—	—	4·8	—
Orthoclase	—	7·8	—	—
Albite	—	44·5	—	—
Oligoclase (Ab_2 An_1)	35·0	—	—	—
Labradorite (Ab_1 An_1)	—	—	—	41·4
Labradorite (Ab_1 An_2)	—	—	36·4	—
Muscovite (Sericite)	14·1	—	3·9	—
Biotite	—	10·4	6·5	23·0
Hornblende...	22·5	19·1	15·4	21·3
Magnetite	3·0	—	—	—
Ilmenite	0·9	—	—	—
Sphene	—	0·6	0·6	0·8
Apatite	1·7	—	—	0·7
Calcite	—	1·8	0·3	—
Minor constituents	0·8	0·4	0·6	0·7
	100·0	100·0	100·0	100·0

Much of the alumina shown in the above as corundum is probably present as kaolinite or as diaspore.

The gneisses may be classified as follows :—

Granite-gneiss	North-Western district	Vulcanose.
,, ,,	Cuyuni River	Yellowstonose.
,, ,,	Mazaruni River	Lassenose.
,, ,,	Essequibo River	Yellowstonose.
Hornblende-granitite-gneiss,	Cuyuni River,	Toscanose.
,, ,, ,,	Mazaruni River,	Pantellerose.
,, ,, ,,	Essequibo River,	Bandose.
Diorite-gneiss	Mazaruni River	Andose.

The Epidiorite, Amphibolite and Hornblende-schist Group.—The gneiss of the colony is traversed by a series of rocks originally basic intrusives and now epidiorites, amphibolites and hornblende-schists, which form well-marked features in the topography of the gneissose districts, giving rise to ranges of hills and to isolated knolls easily distinguished from the surrounding gneissose penoplains. In the river courses the basic rocks are frequently the cause of small cataracts and rapids.

The rocks of the group fall into two classes according to the intensity of the dynamo-metamorphic forces which have affected them ; those less affected, the epidiorites and amphibolites, in some places retaining as kernels to plates of hornblende portions of the pyroxenes of the original intrusive rocks which they now represent, whilst in the other —the hornblende-schists—no traces of the original ferro-magnesian minerals are seen. In many parts of the country it is not easy to connect the well-foliated hornblende-schists with the massive epidiorites and amphibolites, but in the Blue Mountain district and in the Mazaruni-Puruni district, where these rocks occupy very large areas, the transitions from the massive rocks through actinolitic ones to true hornblende-schists can be traced both in the field and in thin slices under the microscope, while at one place on the Cuyuni River I found a series of rocks showing the transition from a gabbro to a hornblende-schist. In the following accounts the rocks are arranged in inverse order to the degree of metamorphism to which they have been subjected.

In the belt of basic rocks which cross the Mariwa or north-eastern channel of the Cuyuni River at and near the Upper Mariwa Rapids, from one of the spurs of the Blue Mountain hills a change from gabbro to amphibolite and thence to hornblende-schist can be followed, and this shows that the basic intrusives of the district were rocks of the gabbro-diabase type. The following varieties of rock are found at these rapids :—

Below the rapids is a purplish rock of specific gravity 2·84, which consists of a granitic aggregate of labradorite, some microcline, and some interstitial quartz, plates of almost colourless augite, with some peripheral chlorite and serpentine, many of the augite plates with numerous extruded grains of magnetite, a little enstatite, some bronzite, many plates of brown biotite secondary from the pyroxenes, some large granules of magnetite, and a few prisms of apatite. The rock is traversed by minute cracks filled with serpentine. It is a gabbro or a biotite-gabbro.

Near the foot of the rapids somewhat to the west of the preceding rock, but in the same belt, a dark-grey rock of specific gravity 3·08 occurs. This rock shows in places a transition from a massive to a foliated structure. A slide showing the transition from one into the other was prepared, and it showed that the rock consists of a mosaic of granules of feldspar, both striated and water-clear, in one part of which are masses of colourless augite with many extruded grains of magnetite, while in the other part the pyroxenes are more or less replaced by a green hornblende, having here and there kernels of a ferriferous enstatite, whilst extruded magnetite forms large irregular granules. Some granules of magnetite, with borders of leucoxene, are also present in both parts. The part which contains the augite altered to hornblende has a perceptibly foliated structure.

At the foot and middle of the rapid specimens were obtained of a schistose dark-coloured variety of the rock, of specific gravity 2·97, having the following structure:—

Areas of labradorite in laths, with well-defined edges, in parts showing the commencement of granulitisation, in others broken up into aggregates of small granules; large patches of green hornblende, some with very abundant extruded grains of magnetite, and with numerous small kernels of augite, many scattered small crystals of hornblende, some patches of zoisite and some grains of epidote. The greater part of the rocks exposed at the rapids consists of this variety.

Near the head of the falls is a belt of a well-foliated variety, dark-grey in colour, and of specific gravity 2·81. This rock is made up of a mosaic of granules of water-clear feldspar, and of masses of green hornblende, more or less broken up into granules, and in places partly altered to chlorite. Epidote is present in small granules in some abundance. Small flakes of chlorite after biotite are also found. Grains of magnetite occur scattered here and there through the rock. It possesses a well-marked fissile structure.

The series of specimens collected below and at the Upper Mariwa Rapids, show very clearly the passage of rather fine-textured gabbro into epidote-hornblende-schist.

Proterobase.—On the southern peak of the Blue Mountain Hills, at an altitude of about 700 feet, a dark-coloured, compact rock, having a specific gravity of 3·0, occurs. It is made up of plates of nearly colourless augite changed at their peripheries to pale-green hornblende; in places there are patches of hornblende which show no indications of pyroxene, but, as a rule, even in the more altered parts, more or less of the original augite remains as kernels in the masses of hornblende. In the less altered augite plates the effects of strain are well marked. The ferro-magnesian minerals occur in an ill-defined feldspar-mosaic, the granules of which, though apparently clear and unaltered, show a mottled appearance under polarised light. Some zoisite and a little epidote have been developed in the feldspars, and some large elongated granules of sphene of the leucoxene type are present.

Proterobase occurs in narrow dykes in the Essequibo and Mazaruni districts. The rocks of these vary in specific gravity from 2·94 to 3·01. Some of the Essequibo rocks are dark-green in colour, compact in texture, and contain large porphyritic crystals of labradorite which in places attain a length of two inches. These phenocrysts in the rock of a dyke at Dehalabani are usually clear, while those in one at Akenna are white and clouded. The compact portions of the rocks consist of small masses of colourless augite enclosed in pale-blue and green hornblende, the ragged internal edges of which seem to interpenetrate their kernels of augite. In places these minerals are replaced by patches of chlorite. Labradorite is present in abundance in small lath-shaped crystals, in places clear, in others more or less clouded, whilst a few small granules of quartz, many irregularly shaped grains of titaniferous iron-ore here and there with leucoxene, and a few crystals of pyrite are present as accessories. The phenocrysts of labradorite are corroded by their matrix, show a zoned structure, and are in places much saussuritised, whilst in others they contain minute inclusions of epidote, sericite and carbonates.

Other dykes of this rock are not porphyritic, the mass having a structure closely resembling that of the compact parts of the rock at Dehalabani and Akenna.

Epidiorite and Amphibolite.—The general structures of the epidiorites and amphibolite are well seen in the rocks of the Aruka Hills in the North-Western district, of the Blue Mountain Range near the Cuyuni River, from near Wariri on that river, and of the broad belt of country extending for several miles south of the Turesi Falls on the Mazaruni River, and of the Tiger Creek of the Puruni River. Smaller masses occur in many places, as, for instance, at the Barima Mine, and frequently in relatively narrow dykes in the North-Western district, along the courses of the Cuyuni and the Mazaruni Rivers, and to a less extent in the Essequibo, Potaro, Demerara and Berbice districts.

The epidiorites and amphibolites from the various districts have many characters in common. Macroscopically they are dark-green, grey or almost black rocks, of specific gravities ranging from 2·82 to 3·18.

The amphibole in them is almost entirely of secondary origin, but occasionally small plates of original olive-green or brown hornblende are found. The hornblende usually present in them is, in thin sections, either colourless, or of various shades of pale-green, pale-blue, olive-green, green and dark-green. It is usually in large, irregular, ragged-edged plates and aggregates, but in some specimens it is in small plates or grains of the deeper-coloured varieties. In places the masses of

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IV.—i.

AMPHIBOLITE, × 12,
WARIRI, CUYUNI RIVER.

Photo by J. Williams.

ii.

HORNBLENDE SCHIST, × 40,
ITABALLI, MAZARUNI RIVER.

hornblende are poikilitic in structure, while in a few cases they retain the ophitic structure which characterised the pyroxene from which they have been derived. Not unfrequently, as in specimens from the Blue Mountains and from the Mazaruni-Puruni district, the light-coloured masses of hornblende surround kernels of almost colourless pyroxene, usually augite, but in some of the rocks from the Blue Mountains the kernels consist of enstatite or of bronzite. In places the hornblende has become actinolitic, and is frayed out towards its edges into minute crystals of colourless amphibole, which in cases appear to run in streams from and round the aggregates of the mineral.

The feldspar is usually a more or less basic labradorite, which in some specimens retains it crystalline form, the laths, however, being more or less sericitised. More usually it occurs as either confused ill-defined mosaics of clouded granules, or well-defined granular aggregates of water-clear plates, the great majority of which are unstriated, whilst some exhibit the striæ of plagioclase, or in a very few cases the structure of microcline. Minute prisms of zoisite and of epidote are frequently present in the feldspar, the former in places in some abundance, the latter usually in very subordinate quantity, while in some specimens the feldspar areas contain numerous minute needles and hair-like fibres of colourless hornblende. Grains of secondary quartz occur in addition to those of feldspar in some of the granular mosaics. Small irregularly shaped granules of titaniferous iron are present in small quantity, and are usually coated with leucoxene. In places the masses of hornblende contain many minute grains of extruded secondary magnetite. In a few specimens small flakes of more or less chloritised biotite are present, but are only sparsely distributed. A few small prisms of apatite occur in the rock, and in some specimens minute crystals of zircon are found. Aggregates of chlorite are present in many specimens, but, as far as I have observed, this mineral seldom forms an important accessory.

Actinolite- and Hornblende-schists.—In many places rocks occur, in which the effects of metamorphism have been far greater than in the epidiorites and amphibolites. These seldom contain any residuary pyroxene, whilst the hornblende masses are either largely or entirely broken up into actinolite, or into small allotriomorphic grains of green hornblende. In places the hornblende masses are altered into more or less fibrous aggregates of uralite. The rock has to a varying extent a schistose structure, which in many places is not noticeable in hand-specimens, although clearly seen in thin sections; in other places the rock has the well-marked characteristics of a schist in hand-specimens as well as in thin sections.

The actinolite-schists vary in specific gravity from 2·89 to 2·94, and are made up of felted masses of pale-blue to almost colourless actinolite, and of streams of needles, and of long and narrow laths of the same mineral, patches of chlorite, small irregularly shaped grains of titaniferous iron ore, and minute crystals of magnetite lying in a micromosaic of feldspar with some quartz. In the mosaic the feldspar granules are usually water-clear, but some show the striæ of plagioclase; in places in the mosaic plates of feldspar larger than its granules are found, these are usually clouded with sericite, and many of them contain needles of colourless actinolite. Small prisms of apatite sparsely occur in the mosaic and in the masses of actinolite. As unimportant accessories small grains of sphene of the leucoxene type, prisms of zoisite, granules and crystals of epidote and plates of carbonates are found.

The hornblende-schists are darker-coloured than the actinolite-schists, and vary in specific gravity from 2·82 to 3·04. They are made up of allotriomorphic granules of green, olive-green or bluish-green hornblende with others of a usually water-clear plagioclase-feldspar, and with here and there minute grains of magnetite, of titaniferous iron-ore and of pyrite. In some specimens the granules of hornblende and of feldspar are of sensibly similar size, but as a rule the grains of hornblende are much larger than are those which form the granular aggregates of plagioclase-feldspar. Not unfrequently granules of quartz occur in the mosaic, whilst the rocks are traversed by thin films and narrow veins of the same mineral. In places the quartz veins pass into lenticular masses, or gradually become of considerable thickness—from a few inches to as much as four or five feet across—and extend as sheets for long distances through the rock. These sheets, or reefs as they are termed in the colony, are frequently more or less auriferous, whilst in a few places the lenticular masses are auriferous to a marked degree.

The accessory minerals present in the hornblende-schists—usually in very unimportant quantities—are apatite, sphene and zircon, whilst chlorite, epidote, zoisite and carbonates occur in very varying proportions and not unfrequently form thin layers and veins in the rock.

In some places epidote is an important constituent of the mass of the schist; it is then usually granular, but it is also found in small prisms. These epidote-hornblende-schists are otherwise similar in structure and in composition to the hornblende-schists, of which they are local modifications.

Another variety occurs in which chlorite is an important constituent. A typical example is found near the portage at Arawak Matope Cataracts on the Cuyuni River; it is there a dark-green, well-foliated rock of specific gravity 2·89. It is composed of a very pale-blue hornblende, varying in structure from more or less frayed-out plates to needles in felted masses, the degree of schistosity of the rock being governed by the state of aggregation of the hornblende. In some of the less altered masses of hornblende the structure suggests the presence of small nuclei of augite, but these are seldom recognisable. The ground-mass of the rock consists of a micromosaic of water-clear feldspar with some quartz, grains of epidote, fairly abundant patches of pale chlorite and viridite, many needles of actinolite, some minute cubes of magnetite and a few of pyrite. Here and there flakes of chloritised biotite are seen.

Talc-schist.—In the Cuyuni River, south-west of Swarima Island near Wariri, hornblende-granitite-gneiss is traversed by a broad dyke of zoisite-amphibolite, the inner part of which, for about 500 yards in breadth, consists of a mass of light-coloured hornblende-rock, parts of which are more or less altered, being in places changed into a pale-greenish rock, having a soapy feel and being easily scratched by the finger-nail.

The amphibolite is a greenish-grey rock and varies from fairly compact to porphyritic. The latter is made up of relatively large crystals of a colourless amphibole in a confused grey matrix of zoisite and feldspar, the striæ of plagioclase being here and there faintly visible. The amphibole-phenocrysts usually have frayed-out edges, and in places a little chlorite is developed in them. The specific gravity of the rock varies from 2·86 to 2·97 according to the relative abundance of hornblende it contains. The amphibolite where not altered has a specific gravity of 3·01, and is made up of a very pale-blue, almost colourless, hornblende with some smaller crystals of a green one. The edges of the larger masses are actinolitic, and the masses contain in places prisms of epidote. Between the masses of hornblende are some irregular areas of epidote and zoisite. A few minute crystals of magnetite have been extruded from some of the masses of hornblende.

Where the rock appears to be only very slightly altered its specific gravity is 3·02, and it is made up of large masses of colourless hornblende somewhat altered, and having their cleavages marked by abundant minute extruded grains of magnetite. Many of the masses show a uralitic structure, and some contain patches of a very pale chlorite. A little colourless pyroxene is present in places.

Where the alteration commences to be readily noticeable the rock has a specific gravity of 2·99, and is generally similar in composition and structure to the very slightly altered rock, but grains of extruded magnetite are more abundant, and areas of pale chlorite and of serpentine are noticeable. Where patches of feldspar occur they are invaded by colourless needles of hornblende and are rendered cloudy by zoisite. Many flakes of talc and of sericite are found in places.

The completely altered rock has a specific gravity of 2·91, the large plates of hornblende being entirely metamorphosed, with extrusion of magnetite, into a complex of talc, with some serpentine and chlorite.

This is an interesting case of the alteration of a norite, or of a gabbro, the pyroxenes of which were made up largely of the enstatite-molecule, into a zoisite-amphibolite, and of the more basic parts into a talc-serpentine rock or talc-schist.

THE CHEMICAL AND MINERALOGICAL COMPOSITIONS OF THE EPIDIORITES, AMPHIBOLITES, AND HORNBLENDE-SCHISTS.

The chemical compositions of these rocks are as follows :—

NORTH-WESTERN DISTRICT.

	Epidiorite.			*Hornblende-schist.*
	Issorora Hill, Aruka River.	Arakaka District.	Urinambo Hill, Barama River.	Maburima Hill, Aruka River.
Silica	49·06	49·46	52·78	50·28
Alumina	18·87	16·77	13·66	15·72
Iron peroxide	1·89	1·98	2·40	2·26
Iron protoxide	4·49	6·57	8·64	10·35
Magnesium oxide	10·95	9·33	7·95	9·06
Calcium oxide	11·70	11·17	9·52	10·10
Sodium oxide	0·97	1·55	2·34	1·79
Potassium oxide	0·06	0·04	0·20	0·16
Water	0·43	2·02	1·89	0·40
Carbonic anhydride	—	0·27	—	—
Titanium oxide	0·88	0·79	0·23	9·07
Phosphoric anhydride	trace.	trace.	—	—
Iron sulphide	0·02	trace.	0·02	0·02
Manganese oxide	0·34	trace.	0·11	trace.
	99·66	99·95	99·74	100·21

MAZARUNI-CUYUNI DISTRICT.

	Epidiorite.	*Amphibolite.*	*Hornblende-schist.*	*Hornblende-chlorite-schist.*
	Mazaruni River.	Puruni River.	Mazaruni and Puruni Rivers.	Arawak Matope, Cuyuni River.
Silica	49·83	49·66	52·40	46·67
Alumina	15·11	10·25	12·73	13·14
Iron peroxide	9·78	11·00	9·50	3·74
Iron protoxide	2·57	8·95	4·83	13·25
Magnesium oxide	7·55	6·06	6·49	5·93
Calcium oxide	8·92	8·26	9·12	9·30
Sodium oxide	2·84	2·43	2·42	1·76
Potassium oxide	1·32	0·63	1·03	0·41
Water	1·00	1·37	0·70	4·39
Carbonic anhydride	0·09	0·10	0·12	0·44
Titanium oxide	0·16	1·08	0·34	0·77
Phosphoric anhydride	0·17	0·17	0·11	trace.
Iron sulphide	—	—	—	trace.
Chlorine	0·02	0·17	0·06	0·07
Cobalt oxide	0·64	—	0·12	—
Manganese oxide	0·05	0·20	0·15	0·27
Barium oxide	—	—	0·01	0·12
Copper	0·05	—	—	trace.
Lead...	0·01	—	—	—
	100·11	100·33	100·13	100·26

CUYUNI RIVER, NEAR SUARIMA ISLAND.

	Epidiorite (zoisite-amphibolite).	Amphibolite (massive).	Amphibolite (altering).	Talcose serpentine rock.
Silica	46·19	49·18	51·37	51·57
Alumina	18·63	10·52	3·20	2·15
Iron peroxide	0·06	1·70	0·89	2·48
Iron protoxide	5·06	7·10	5·97	6·28
Magnesium oxide	9·05	15·98	21·78	25·82
Calcium oxide	13·57	10·17	11·18	3·69
Sodium oxide	2·83	1·36	0·83	0·15
Potassium oxide	0·75	1·24	0·11	0·04
Water	1·04	1·89	2·66	4·63
Carbonic anhydride	—	0·54	0·26	2·21
Titanium oxide	0·45	0·29	0·80	0·60
Phosphoric anhydride	trace.	—	—	trace.
Chlorine	0·05	0·014	0·02	0·04
Iron sulphide	—	0·009	—	—
Cobalt oxide	—	0·006	—	—
Manganese oxide	0·40	0·26	1·02	0·46
Barium oxide	0·10	0·16	0·10	0·10
Copper oxide	trace.	0·005	trace.	trace.
Lead oxide	—	—	—	trace.
	100·18	100·424	100·19	100·22

ESSEQUIBO DISTRICT.

	Epidiorite.	Hornblende-schist.
Silica	51·74	51·70
Alumina	14·26	15·94
Iron peroxide	3·67	3·84
Iron protoxide	10·08	10·56
Magnesium oxide	6·86	5·54
Calcium oxide	8·78	9·60
Sodium oxide	2·65	1·87
Potassium oxide	0·26	0·08
Water	0·16	0·30
Carbonic anhydride	0·18	—
Titanium oxide	0·78	0·30
Phosphoric anhydride	0·025	0·012
Copper oxide	—	trace.
Lead oxide	trace.	—
Iron sulphide	0·002	trace.
Manganese oxide	0·14	trace.
	99·587	99·742

The following minerals have been recognised in the rocks of this group :—

Bytownite, labradorite, water-clear feldspar, quartz, augite, enstatite, hornblende, epidote, chlorite, magnetite, titaniferous iron-ore, leucoxene, sphene, serpentine, talc, zircon, apatite, zoisite, pyrite, zeolites, and calcite.

The foregoing analyses correspond to the following mineralogical compositions :—

NORTH-WESTERN DISTRICT.

	Epidiorite.			*Hornblende-schist.*
	Issorora Hill, Aruka River.	Arakaka District.	Urinambo Hill, Barama River.	Maburima Hill, Aruka River.
Quartz	1·3	1·5	4·4	1·1
Orthoclase	0·5	0·2	1·1	49·4
Bytownite (Ab_1 An_3)	—	50·1	46·0	—
Anorthite (Ab_1 An_{10})	55·1	—	—	—
Hornblende and augite	38·0	44·0	42·3	46·0
Magnetite	2·8	—	3·5	3·2
Ilmenite	1·7	1·5	0·5	0·1
Minor constituents	0·6	2·7	2·2	0·2
	100·0	100·0	100·0	100·0

MAZARUNI-CUYUNI DISTRICT.

	Epidiorite.	*Amphibolite.*	*Hornblende-schist.*	*Hornblende-chlorite-schist.*
	Mazaruni River.	Puruni River.	Mazaruni and Puruni Rivers.	Arawak, Matope, Cuyuni River.
Quartz	1·6	9·8	10·1	—
Sericite	—	—	—	2·6
Orthoclase	7·8	3·3	6·1	—
Labradorite (Ab_1 An_2)	48·3	—	41·3	—
Labradorite (Ab_2 An_3)	—	36·0	—	—
Bytownite (Ab_1 An_4)	—	—	—	41·2
Hornblende...	29·5	31·1	27·0	30·1
Chlorite	—	—	—	24·0
Magnetite	9·7	16·0	13·7	—
Ilmenite	0·3	2·1	0·6	1·5
Apatite	0·3	0·3	0·3	—
Calcite	—	—	—	1·0
Minor constituents	—	1·4	0·9	—
	100·0	100·0	100·0	100·4

CUYUNI RIVER, NEAR SUARIMA ISLAND.

	Epidiorite (zoisite-amphibolite).	*Amphibolite.*	*Amphibolite (altering).*	*Talcose Serpentine Rock.*
Orthoclase	4·5	7·2	0·6	0·3
Albite	16·8	11·0	1·6	1·3
Zoisite	31·0	—	5·2	3·6
Hornblende...	46·8	78·2	34·7	—
Talc	—	—	38·5	71·5
Serpentine	—	—	15·1	12·7
Ilmenite	0·8	0·6	1·5	1·2
Magnetite	0·2	2·5	1·0	2·6
Calcite	—	1·1	0·6	5·0
Minor constituents	—	—	1·2	1·8
	100·1	100·6	100·0	100·0

ESSEQUIBO DISTRICT.

	Epidiorite.	*Hornblende-schist.*
Quartz	4·1	7·6
Orthoclase	1·7	0·5
Andesine (Ab_3 An_2)	30·8	—
Labradorite (Ab_2 An_3)...	—	30·9
Hornblende	56·0	53·9
Magnetite	5·3	5·6
Ilmenite...	1·5	0·6
Calcite	0·5	0·7
Minor constituents	0·1	0·3
	100·0	100·0

The epidiorites and hornblende schists belong to two classes; in the first of which, represented by many of those of the Mazaruni-Cuyuni district, the hornblende is chiefly uralitic passing to actinolite, the formation of which has been accompanied by the extrusion of relatively high proportions of magnetite from the original pyroxenes, whilst in the second—the majority of those from the North-west and the Essequibo districts—the original pyroxenes have re-crystallised as green hornblende with smaller proportions of extruded magnetite.

According to their ultimate mineralogical compositions these rocks belong to the following classes:—

Epidiorite, Issorora, North-Western district	Kedabekose.
,, Arakaka district	,,
,, Urinambo, North-Western district	Auvergnose.
Hornblende-schist, Maburima, North-Western district ...	,,
Epidiorite. Mazaruni River	Camptonose.
Amphibolite, Mazaruni-Puruni district	Auvergnose.

Hornblende-schist, Mazaruni-Puruni district	Auvergnose.
Hornblende-chlorite-schist, Arawaka Matope, Cuyuni River	,,
Zoisite-amphibolite, Cuyuni River	Hessose.
Amphibolite, Cuyuni River	Auvergnose.
,, (altering), Cuyuni River	Cecilose.
Talcose serpentine, Cuyuni River	Minnesotiase.
Epidiorite, Essequibo River district	Auvergnose.
Hornblende-schist, Essequibo River district	,,

As a general rule wherever epidiorites, amphibolites or hornblende-schists occur in the colony, the products of their decomposition—which are similar to those of diabase—yield gold in greater or less quantity; and the gold found in parts of the North-west district, in the Puruni district, in the Cuyuni district, and in the Groete Creek district is mainly derived from them. Their contents of the precious metal has been determined in average samples from various districts and places as follows:—

Issorora, Aruka River	8	grains per ton of the rock.
Maburima Landing, Aruka River ...	32	,, ,, ,, ,,
Maburima Hill, Aruka River	7	,, ,, ,, ,,
Youpu, Aruka River	4	,, ,, ,, ,,
Araua Hill, Aruka River	3	,, ,, ,, ,,
Mazaruni River district	8	,, ,, ,, ,,
Puruni River district	5	,, ,, ,, ,,
Essequibo River district	12	,, ,, ,, ,,
Konawaruk River	32	,, ,, ,, ,,
Konawaruk River, No. 2	48	,, ,, ,, ,,
Amphibolite, Cuyuni River	3	,, ,, ,, ,,
Hornblende-chlorite-schist, Cuyuni River	4	,, ,, ,, ,,

These show that in the epidiorites and hornblende-schists gold occurs in sufficiently high proportions for them to become the sources of gold in payable quantities when the metal has been set free and concentrated by the decomposition of the rock and subsequent detrition of the laterite resulting from it.

The gold in part accompanies the heavy minerals of the metamorphosed rocks; but in some of them it is present in the numerous tongues and veinlets of quartz which traverse them, filling cracks and spaces between, or crossing the folia of the schists.

Black sands were separated by panning from the gravelly contents of pot-holes in the Wariri belt of amphibolite, and were freed from quartz and feldspar by treatment with Sonstadt solution. They were free from gold in the form of visible specks, but they yielded upon assay gold and silver at the rates respectively of 118 and 150 grains per ton of the sand.

Where the epidiorites and hornblende-schists are intersected by later dykes of diabase, as in parts of the Arakaka district in the North-west, we find quartz veins and alluvial deposits containing the metal in exceptionally high proportions.

Quartz veins traversing amphibolites, epidiorites or hornblende-schist may be expected to be more or less auriferous.

The very rich mass of quartz at the Peter's Mine in the Puruni River has epidiorite and hornblende-schist for its country-rocks.

CHAPTER VII.

THE PETROGRAPHY OF THE QUARTZ-PORPHYRY, GRANOPHYRE, PORPHYRITES, AND ALLIED ROCKS.

THESE rocks are developed to a considerable extent in British Guiana, and in parts occupy very broad areas. They are of at least two ages, the more important variety being older than the granitic rocks whilst of later date than the fundamental gneiss, the less important and relatively rare kind being either offsets from the granitic rocks, or later intrusions through them. The latter will be described with the granitic rocks.

The series includes both massive and schistose members, the latter being derived from the former by dynamic metamorphism.

The massive varieties are divisible into the following groups :—

1. Quartz-porphyry and quartz-porphyrite.
2. Granophyre.
3. Feldspar-porphyrite.
4. Augito-porphyrite.
5. Hornblende-porphyrite.
6. Felsite.

No strict lines of demarcation can be drawn between these groups, as they shade almost imperceptibly from one into another. Similarly, it is not possible to demarcate the massive from the schistose varieties, the change from one to the other being very gradual. I have classed as quartz-porphyries, or as quartz-porphyrites, rocks containing numerous blebs or phenocrysts of quartz, whether accompanied or not by phenocrysts of feldspar, in a microgranitic, microgranular, microcrystalline, granophyric, or felsitic groundmass ; as porphyrite those with phenocrysts of plagioclase-feldspar in a microgranitic, microgranular microcrystalline, or felsitic groundmass ; as augite-porphyrite those with phenocrysts of augite ; as hornblende-porphyrite those with phenocrysts of hornblende ; as granophyre those containing phenocrysts of feldspar, and a few of quartz in a micropegmatic groundmass ; and as felsite some rocks which do not contain phenocrysts, and which usually have either a microgranitic or a microgranular structure, but in places consist of an irresolvable felsitic mass.

As a rule the plagioclase-feldspars are far more in evidence in the rocks containing blebs or phenocrysts of quartz than are the orthoclase ones, and hence the term quartz-porphyrite is generally more applicable to them than is that of quartz-porphyry.

1. (*a*) *Quartz-porphyry.*—The quartz-porphyries are compact rocks, varying in colour from greenish-grey to very dark grey, and ranging in specific gravity from 2·57 to 2·74. Their groundmass is either microcrystalline, micrographitic, microgranular, or micropegmatitic. In the microcrystalline varieties the interlacing, minute, lath-shaped crystals of feldspar, usually plagioclastic, show more or less corroded edges, and have, in varying degrees, the more or less noticeable flow arrangement termed "pilotaxitic." The microgranitic, microgranular and granophyric matrices are composed of feldspar and quartz, the former usually being predominant. The feldspar consists of orthoclase and plagioclase in varying proportions. Sericite is of frequent occurrence, sometimes in considerable quantity, while minute granules of epidote are found in places scattered through the mass.

Small rounded blebs of quartz, more or less corroded by the matrix, and usually of uniform extinction, but in some specimens showing strain shadows, and phenocrysts of feldspar—generally orthoclase, but in places plagioclase—of very varying sizes, are scattered through the groundmass. Many of the orthoclase-phenocrysts are clouded by sericite, while, in places, the plagioclase ones contain numerous minute granules and crystals of epidote. In some specimens small patches of colourless augite, more or less changed to epidote, nests of chloritised biotite, small scales and aggregates of greenish biotite, and a few small flakes of muscovite occur, whilst small patches of pale green hornblende are sparsely present. Minute crystals and grains of magnetite and of titaniferous iron ore, granules of sphene, small prisms of apatite, patches of carbonates, and crystals of pyrite are accessories, usually in unimportant quantities.

Some quartz-porphyries from the Berbice River district are either pink, red or purple in colour, contain numerous small blebs of quartz and dull earthy-white phenocrysts of feldspar, and have a finely laminated structure. They appear to have been originally tuffs. Their groundmass is crypto-crystalline or felsitic, and in parts contains a good deal of glass. Minute, irregularly shaped blebs of glass occur in places. Some of the rocks are more or less silicified and are traversed by narrow veins of quartz.

The principal interest in the rocks of the Berbice River lies in the quartz-porphyry and allied rocks. They differ from rocks of the same group collected in the auriferous districts of the colony by showing fewer signs of dynamic metamorphism, and by retaining in some cases their original hyalopilitic or pilotaxitic structures sufficiently to enable an opinion to be formed as to their origin. They have been either rhyolites and andesites, or altered and consolidated tuffs derived from similar rocks.

Quartz-porphyrites.—The quartz-porphyries grade almost imperceptibly into quartz-porphyrites, the latter differing from the former by the smaller proportions of orthoclase-feldspar present in them, whilst the feldspar-phenocrysts consist only of plagioclase.

2. *Granophyre.*—In many places, especially in the vicinity of the larger intrusive masses of diabase, quartz-porphyries and porphyrites having a micropegmatitic groundmass occur. They are compact rocks with usually inconspicuous blebs of quartz, and many phenocrysts of feldspar. In colour they vary from light grey to greyish-green and, as a rule, are of the lighter shade. Their specific gravities range from 2·62 to 2·72. The rocks are made up of a groundmass of a micro-pegmatite of quartz and feldspar, the latter in places being orthoclase, in others albite, in which are embedded small blebs of quartz and abundant phenocrysts of plagioclase, and occasionally of orthoclase. In places the micropegmatite is replaced by granitic or granular aggregates of quartz and feldspar. The phenocrysts and the accessory minerals are similar to those described as present in the quartz-porphyries and porphyrites.

Feldspar-porphyrites.—These rocks differ from the foregoing by not containing blebs or phenocrysts of quartz and the feldspars are generally plagioclastic. Phenocrysts of plagioclase, and, in a few instances, of orthoclase, are present, the former usually in abundance. The rocks range in colour from greenish-grey and bluish-grey to dark-green, dark-grey and purplish-grey, and in specific gravity from 2·68 to 2·82. Their groundmass is either microgranular or microgranitic, and consists of feldspar with some quartz. Lying in the groundmass are relatively large phenocrysts of plagioclase-feldspar, frequently clouded with sericite, zoisite and epidote. Small nests and patches of green biotite, of chlorite, and of epidote occur scattered in the rock. The accessory minerals present are the same as those found in the quartz-porphyries and quartz-porphyrites.

In some of the feldspar-porphyrites the groundmass is made up of ill-defined laths of feldspar, which in places passes to a feldspar-micromosaic. These are greenish-grey rocks of specific gravity from 2·70 to 2·82. In addition to phenocrysts of feldspar they contain a few small ones of a colourless augite, or of a pale hornblende. Chlorite, viridite, sericite and epidote are frequently present in the groundmass.

In the lower parts of the Potaro River,—but, as far as my experience goes, rarely elsewhere,—feldspar-porphyrite occurs having for groundmass minute interlacing lath-shaped crystals of feldspar, many of which are plagioclase, their edges being more or less corroded. They have a pilotaxitic arrangement, the feldspar-laths lying in streams with their longer axes approximately parallel to one another. These rocks contain small phenocrysts of feldspar, but not in any abundance. Their accessory minerals are the same as those found in the porphyries, but, as a rule, they are present in very small proportions, or are almost entirely absent, whilst the ferromagnesian minerals seldom, if ever, occur. The rocks are essentially feldspathic ones closely allied to Bostonite.

Some specimens from the Cuyuni and Berbice Rivers are grey and purplish-grey rocks of specific gravity 2·75 to 2·78. The groundmass of these is distinctly andesitic and flow-structure is fairly well marked in them. They differ from the rocks of the Bostonite type by containing small phenocrysts of augite and flakes of more or less chloritised biotite.

4 and 5. *Augite- and Hornblende-porphyrites.*—Porphyrites having well-marked phenocrysts of augite and hornblende are of far less common occurrence than are the quartz and feldspar-porphyrites. Some of them resemble consolidated tuffs, and probably have originated from volcanic *débris.*

4. *Augite-porphyrite.*—This is a dark-grey rock of specific gravity from 2·85 to 2·86. As a rule its groundmass is a confused micro-crystalline to microgranular mosaic of feldspar with chlorite, epidote, zoisite, sericite, titaniferous iron-ore with leucoxene in minute grains, and some secondary quartz. Colourless hornblende in minute laths and needles and a few flakes of greenish biotite are found in places. Very pale to colourless augite is present in them in small phenocrysts, which in places are more or less fractured, whilst some of them have actinolitic borderings. Some phenocrysts of plagioclase also occur in the augite-porphyrites.

5. *Hornblende-porphyrite.*—The groundmass of the hornblende-bearing porphyrites is very similar to that of the augite-porphyrites, but, as a rule, needles of colourless hornblende are more abundant in it than in that of the latter. Some specimens are traversed by films of secondary biotite. The hornblende-phenocrysts vary considerably in size in different specimens. The hornblende is very pale-green to very pale-blue in colour, and in some specimens occurs in laths and in patches as well as in phenocrysts. In some places the hornblende is more or less changed to epidote, whilst here and there the phenocrysts are bordered with numerous minute grains of magnetite extruded from them. The rocks contain small phenocrysts of plagioclase-feldspar, usually clouded by inclusions of sericite, zoisite, and epidote. The hornblende-porphyrite is compact in structure, greenish-grey to dark-grey in colour, and in specific gravity it varies from 2·77 to 2·89.

6. *Felsite.*—This forms very compact rocks of various shades of grey to almost black, and of green, red, chocolate-coloured, dark brown, and deep purple. It varies in specific gravity from 2·62 to 2·78. It is made up of either a crypto-crystalline mass, containing in places granules of glass, or of a very finely grained micro-mosaic of feldspar with sericite and some quartz. In the darker-coloured varieties, chlorite and widely diffused minute grains of magnetite are present in some quantities. In the red and chocolate coloured sorts hematite is found in a very finely divided state. Films and thin veins of quartz in places traverse the rock, whilst some specimens are more or less silicified by secondary quartz. As secondary constituents, carbonates in plates and in patches, and pyrite in small cubical crystals, are often present.

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V.—i.

SERICITE SCHIST, × 60,
MARIWA FALL, CUYUNI RIVER.

Photo by J. Williams.

ii.

MUSCOVITE GRANITE, × 12,
WAINI RIVER.

(*See* PAGE 69.)

Photo by J. Williams.

Tuffs.—Below Anaripia Itabu, and in the Itabu near Pigeon Island in the Cuyuni River are exposures of a very fine-grained brown-coloured clastic rock, which is finely bedded, and which, near Anaripia, dips at high angles. It consists of a very fine-grained feldspathic dust, with rarely grains of quartz, the fragments being angular. The finer-textured layers contain minute grains of magnetite in abundance, and alternate with coarser-textured layers, in which the feldspathic fragments are plentifully intermingled with limonite. The rock is cemented with sericitic material, and minute cracks are filled with secondary quartz. Its specific gravity varies from 2·66 to 2·76.

In the Berbice River below Itabru Gate, and at Little Itabru, reddish-coloured rocks occur, having specific gravities from 2·53 to 2·65, and consisting of a crypto-crystalline to a glassy matrix with sericite developed in it. In this are scattered a few grains of quartz, some minute grains of magnetite, and, in places, large numbers of granules of a light-coloured brown to nearly colourless glass. These rocks are traversed in places by narrow veins of quartz.

In the country between Christianburg and Akyma on the Demerara River, a series of much altered rocks occurs. They are generally red to reddish-grey in colour, and resemble indurated clays. They give rise to the hills at Christianburg and at Akyma Their origin is clearly shown on microscopic examination. They were originally either felsites with fluidal structure or bedded tuffs—probably the latter. They are silicified, and the vesicular hollows in them are lined or filled with tridymite.

Somewhat similar rocks, but without vesicles, and cemented by quartz, occur in the Potaro River near the junction of the Kuribrong River, and on the Pomeroon River. In the latter place they are associated with quartz and feldspar-porphyry.

Porphyroids, Sericite and Chlorite-schists.—It is very usual in the porphyries and the porphyrites for the massive sorts to show a more or less gradual change through porphyroids into sericite-schists. This change of massive rocks into fissile ones is caused by a development of sericite-mica from the feldspar of the groundmass, usually accompanied by a development of the same mineral in the feldspar-phenocrysts; of epidote in greater or less abundance, and of very light-coloured actinolitic hornblende, and of chlorite, from the original ferro-magnesian minerals. Where this change has only produced incipient foliation the rocks may be considered as porphyroids, their final stages being either sericitic or chloritic schists, which give little or no indications of their original mineralogical composition.

They fall into three divisions, like the rocks from which they have been produced—sericite-schists containing blebs of quartz derived from the quartz-porphyries, the granophyres, and quartz-porphyrites; sericite-schists free from blebs of quartz derived from the feldspar-porphyrites or the felsites; and chlorite-schists derived from the augite and hornblende-porphyrites. Some of them, however, have been derived from granitic rocks, as, for instance, the sericite and chlorite-schists of the Mariwa Falls on the Cuyuni River.

The following are descriptions of some of the more characteristic samples :—

(*a*) *Schists from Quartz-porphyry, Granophyre and Quartz-porphyrite.*—These more or less well-foliated rocks are usually light-coloured to grey or greenish-grey in hue, though some are dark-grey. Their specific gravity varies from 2·60 to 2·78. They are made up of a micro-granular mosaic of feldspar and quartz, with varying proportions of sericite and subordinate quantities of chlorite, epidote and actinolite. In those which show a well-developed schistose structure sericite is present in abundance in veins, films and streaks. In many specimens blebs of quartz are noticeable, some of them with more or less corroded outlines. These blebs usually show strain-shadows, whilst not unfrequently in places they are much fractured. Phenocrysts of feldspar are noticeable in many specimens, some showing the striæ of plagioclase whilst a few consist of microcline. As a rule, the feldspars are clouded with sericite, zoisite and epidote, while in places their phenocrysts show strain-shadows, or are elongated and otherwise distorted. As minor accessories, wisps of biotite or of chlorite after biotite occur, whilst in some specimens large flakes of much-altered biotite are present, and more or less fractured or elongated, small crystals of sphene and minute grains of magnetite are found. Carbonates are of frequent occurrence as alteration-products, and grains of pyrite are occasionally seen.

(*b*) *Schists from Feldspar-porphyrite, Pegmatite and Felsite.*—Where the metamorphic forces have been most intense in their actions schists, consisting essentially of sericite and quartz, with some albite, have resulted from them. Excellent examples of these occur at the Government Station at Arawak Matope on the Cuyuni River, near the mouth of the Potaro River on its left bank, and near Arakaka on the Barima River.

They are silvery-white, very fissile, soft schists, but in places are stained grey, or are rust-coloured, Their specific gravity is about 2·75. They are made up of a colourless granulitic mosaic of quartz, with some water-clear feldspar, which is traversed by streams and wisps of sericite, and with here and there small patches of chlorite. A few grains of epidote and some sparsely scattered minute grains of magnetite are found. In places the rock contains partings of limonite.

The commoner types of the schists are of very varying colours—for instance, pale-grey to dark-grey, or almost black, cream-coloured, bluish-grey, bluish-purple, ochrey-yellow, red, purplish-red, buff or brown ; in hand-specimens some of them appear to be compact, but the majority show more or less clearly their fissile structure. They vary in specific gravity from 2·76 in the lighter-coloured ones to 2·78 in the darker ones. They consist of a microgranular mosaic of feldspar with quartz, and in the darker varieties with more or less chlorite and some granules of epidote. Sericite is always present in the more compact forms in patches and films scattered through the mass of the rock, and in the fissile ones in streams and veins marking the foliation. In a few places the rock is traversed by streams of minute flakes of greenish-biotite. Small grains of magnetite or of titaniferous iron-ore with leucoxene, of sphene, of epidote, and occasionally cubes of pyrite are present. Phenocrysts of plagioclase commonly occur, and are frequently fractured or more or less distorted. Where not fractured they usually show strain-shadows, and in places exhibit signs of commencing granulation; many of the phenocrysts are clouded with zoisite, and epidote and to a great extent with sericite. The rocks in places contain much calcite and limonite as decomposition products.

(*c*) *Chlorite and Chloritoid-schists.*—Augite and hornblende-porphyrites in an unaltered condition are of somewhat rare occurrence in the colony, but chlorite-schists and other rocks presumably derived from rocks of intermediate composition are of somewhat common occurrence intercalated with sericite-schists.

The chlorite-schists are usually green, greyish-green or dark-green in colour, and they vary in specific gravity from 2·70 to 2·87. They generally have a more or less well-marked silky feel, and are fissile in very varying degree. They are made up of a micro-mosaic of feldspar and some quartz, with actinolitic hornblende, usually colourless, much green chlorite, some sericite, and a few granules of epidote. In the more fissile varieties the mass of rock is traversed by numerous streams of chlorite, and in parts by films and narrow veins of quartz. In some places phenocrysts of plagioclase, generally much altered, are indistinctly seen. In a few specimens plates and patches of pale-green or pale-blue hornblende are present, whilst in others the remains of phenocrysts of augite or of hornblende are represented by more or less angular patches of chlorite, actinolitic hornblende, and epidote. Minute grains of magnetite, of titaniferous iron-ore and of pyrite form unimportant accessories. Plates and patches of calcite are present in many specimens.

Near the junction of the Potaro and Essequibo Rivers some greyish-green compact rocks, varying in specific gravity from 2·73 to 2·82, are found. They have a soapy feel, like that of serpentine, and they differ from the usual class of schistose rocks of the colony by containing chloritoid or ottrelite. Where the leaves of chloritoid traverse the mass in streams the rock assumes a schistose structure. The groundmass of the rock is microgranular, and is made up of quartz with a little feldspar and a good deal of nearly isotropic viridite; some small grains of magnetite and of titaniferous iron-ore are scattered through it, and here and there patches and aggregates of epidote are found in it. Leaves of chloritoid are plentifully scattered through the rock.

Quartz-schist.—Among the schistose rocks bands or belts of quartz-schist are not uncommon. These vary in colour from light-grey through red and brown shades to nearly black. In general appearance the quartz-schist resembles quartzite, but has a more or less well-marked foliated structure. Its specific gravity is from 2·61 to 2·64. The quartz-schist usually consists of a micro-mosaic of quartz grains with a few of feldspar, containing a little chlorite, few to abundant very minute grains of magnetite, a few sparsely distributed small grains of epidote, and in places some flakes of white mica. Some specimens contain specks of hematite, and others flakes of limonite instead of grains of magnetite. As a rule, the quartz-schist is not auriferous, but specimens which I obtained from near Markabu Island in the Cuyuni River yielded gold upon assay at the rate of 15 grains per ton of the rock.

All the rocks of the group under consideration show to a greater or less extent the effects of dynamo-metamorphism, these, in the case of many of the more schistose members, being complicated by later effects due to percolating waters. It is important to note that in this group of rocks the effects have largely been restricted to mechanical ones, to the production of hydrous minerals—for instance, of sericite and chlorite—and to the splitting up of the feldspars with separation of albite and quartz, the result of the latter being shown in the production of the micro-mosaic of feldspar and quartz which forms the mass of many of them.

THE CHEMICAL AND MINERALOGICAL COMPOSITIONS.

The following analyses have been made of rocks belonging to this group:—

MASSIVE ROCKS.

	Quartz-porphyry.	*Granophyre.*	*Quartz-porphyrite.*	*Feldspar-porphyrite.*
	Mazaruni River.	Essequibo River.	Essequibo-Potaro Rivers.	Cuyuni River.
Silica	71·33	67·62	71·50	65·88
Alumina	11·18	17·03	17·44	16·23
Iron peroxide	3·96	1·30	0·45	1·04
Iron protoxide	1·45	1·71	1·96	4·03
Magnesium oxide	0·88	1·51	1·03	1·70
Calcium oxide	2·10	3·11	3·00	3·24
Sodium oxide	3·51	3·86	2·45	4·11
Potassium oxide	3·49	2·63	1·53	1·22
Water	0·92	0·50	0·68	1·45
Carbonic anhydride	0·74	0·10	0·42	0·07
Titanium oxide	0·12	0·34	0·10	0·40
Phosphoric anhydride	trace	0·009	trace	0·13
Chlorine	0·09	trace	trace	0·01
Iron sulphide	0·04	0·002	0·001	0·03
Manganese oxide	0·32	trace	—	0·08
Barium oxide	0·03	trace	trace	0·17
Copper	—	—	—	0·04
	100·16	99·721	100·561	99·83

MASSIVE ROCKS.

	Feldspar-porphyrite.	*Augite-porphyrite.*	*Hornblende-porphyrite.*	
	Essequibo-Potaro Rivers.	Cuyuni River.	Barama River.	Mazaruni River.
Silica	70·96	62·53	55·77	59·89
Alumina	16·64	15·53	15·88	15·85
Iron peroxide	0·22	1·99	2·55	5·21
Iron protoxide	1·48	3·93	9·20	3·82
Magnesium oxide	1·29	1·97	10·09	4·15
Calcium oxide	3·46	5·10	3·11	5·98
Sodium oxide	4·39	5·20	2·30	2·77
Potassium oxide	0·24	1·38	0·23	1·34
Water	0·68	1·94	1·00	0·74
Carbonic anhydride	0·42	—	trace	0·02
Titanium oxide	0·38	0·18	0·09	0·48
Phosphoric anhydride	0·006	0·06	trace	trace
Chlorine	trace	0·014	trace	0·06
Iron sulphide	0·005	0·03	—	—
Cobalt oxide	—	0·002	—	—
Manganese oxide	0·10	0·26	trace	0·12
Barium oxide	trace	0·13	—	0·03
Copper	—	0·04	—	0·07
	100·471	100·286	100·22	100·53

SCHISTS AND TUFFS.

	Quartz-porphyrite-schist.	*Feldspar-porphyrite-schist.*	*Chloritoid-schist.*	*Quartz-sericite-schist.*	
	Essequibo River.	Essequibo River.	Potaro River.	Barima River.	Arawak, Matopo, Cuyuni River.
Silica	71·96	71·62	76·90	80·64	73·77
Alumina	15·69	16·58	15·02	12·93	15·97
Iron peroxide ...	1·62	1·15	0·50	0·19	3·24
Iron protoxide ...	2·04	3·96	4·72	0·29	0·32
Magnesium oxide ..	2·07	1·05	0·58	0·11	0·52
Calcium oxide ..	1·95	2·61	0·50	trace	0·09
Sodium oxide... ...	1·49	1·53	0·11	0·02	0·31
Potassium oxide ...	1·05	0·57	0·01	4 55	4·31
Water	0·14	0·18	1·30	1·40	1·90
Carbonic anhydride ...	1·90	0·22	—	—	—
Titanium oxide ...	0·02	0·42	trace	0·11	—
Phosphoric anhydride	0·006	0·016	0·20	trace	0·01
Chlorine	trace	trace	trace	—	0·01
Iron sulphide ...	0·002	0·004	0·004	—	—
Cobalt oxide	—	trace	—	—	—
Manganese oxide ...	0·14	trace	trace	—	—
Barium oxide ...	—	—	—	—	—
Copper oxide	—	—	—	—	—
Lead oxide	trace	trace	—	—	—
	100·078	99·910	99·844	100 24	100·45

SCHISTS AND TUFFS.

	Hornblende-chlorite-schist.		*Chlorite-schist.*	*Tuff.*
	Arakaka, Barima River.	Lower Barama River.	Mazaruni River.	Cuyuni River.
Silica	55·76	57·56	52·28	61·03
Alumina	16·92	13·83	15·79	20·93
Iron peroxide	1·70	2·46	7·36	7·73
Iron protoxide	5·10	3·63	0·75	1·42
Magnesium oxide	4·14	4·67	5·34	0·16
Calcium oxide	6·94	7·27	8·21	0·35
Sodium oxide	2·74	3·96	1·66	2·58
Potassium oxide	0·03	0·48	1·24	1·76
Water	3·35	2·66	4·25	2·89
Carbonic anhydride	2·74	3·50	2·54	0·09
Titanium oxide	0·41	0·17	0·43	0·67
Phosphoric anhydride	0·05	trace	trace	0·08
Chlorine	trace	trace	0·02	0·012
Iron sulphide	—	—	0·02	trace
Cobalt oxide	—	—	—	0·003
Manganese oxide	trace	trace	0·04	0·06
Barium oxide	—	trace	0·03	0·33
Copper oxide	—	—	0·02	0·13
	99·88	100·19	99·98	100·225

The following are the specific gravities of the rocks of the group :—

	Specific Gravities.		
	Lowest.	Highest.	Mean.
Quartz-porphyry	2·57	2·69	2·63
Granophyre	2·59	2·72	2·66
Quartz-porphyrite	2·63	2·79	2·71
Feldspar-porphyrite	2·57	2·79	2·69
Felsite	2·56	2·78	2·68
Augite-porphyrite	2·85	2·86	2·857
Hornblende-porphyrite	2·81	2·89	2·85
Quartz-porphyrite-schist	2·61	2·79	2·71
Feldspar-porphyrite-schist	2·69	2·74	2·71
Chloritoid-schist	2·78	2·82	2·80
Quartz-sericite-schist	—	—	2·73
Hornblende-chlorite-schist	—	—	2·77
Chlorite-schist	2·71	2·90	2·80
Tuff	2·66	2·76	2·70

Assays made upon representative samples of the rocks of this series, both of the massive and of the schistose varieties, showed that all contain traces of gold and of silver, the average yield being at the rate of 4 grains of gold and 4 grains of silver per ton of the rock.

In places rocks of this class occur which contain much higher proportions of gold than are usually present. These are found in the immediate vicinity of intrusive dykes of diabase, and the metal, probably, was impregnated into the acidic rocks by percolating waters at the time of the intrusion of the diabase. Some of the rocks obtained from the tunnels at the Ironside placer in the Minnehaha District of the Potaro-Konawaruk goldfield gave a mean contents of 65 dwts. of gold and 23 dwts. of silver per ton of the rock; the contents of gold in the various samples examined varying from 31 grains to 300 dwts.

The schistose rocks contain small quantities of gold, the average result of my assays showing them to yield at the rates of from less than 1 to about 3 grains of gold per ton of the rock. In places, however, the quartz-sericite-schists have yielded from 24 to 36 grains of gold to the ton. These have not been included in the above average.

Mineralogical Composition.—The following are the minerals and aggregates of minerals which have been found to be present in the rocks of this group :—

1. Essential.

   Orthoclase, plagioclase, quartz, micropegmatite, biotite, muscovite, augite and hornblende.

2. Accessory.

   (a) *Original.*—Epidote, apatite, sphene, titaniferous iron, magnetite and garnet.

   (b) *Secondary.*—Epidote, sericite, chlorite, chloritoid, viridite, hematite, magnetite, leucoxene, sphene, zoisite, pyrite, gold and calcite.

The probable mineralogical compositions of the rocks of this series which I have examined both microscopically and chemically are as follows :—

MASSIVE ROCKS.

	Quartz-porphyry.	*Granophyre.*	*Quartz-porphyrite.*	*Feldspar-porphyrite.*
	Mazaruni River.	Essequibo River.	Essequibo River.	Cuyuni River.
Quartz	36·0	29·3	46·0	24·9
Orthoclase	18·4	5·5	—	—
Oligoclase (Ab_4 An_1)	33·0	—	—	—
Labradorite (Ab_1 An_1)	—	45·9	31·5	49·6
Muscovite	—	8·4	7·3	8·7
Biotite	5·0	7·9	7·1	—
Hornblende...	0·3	—	—	—
Chlorite	—	—	—	14·6
Corundum	—	—	6·3	—
Sphene	0·2	—	0·2	—
Magnetite	3·9	1·2	—	1·4
Ilmenite	—	0·6	—	0·8
Apatite	—	0·3	—	0·5
Calcite	1·7	0·2	0·9	—
Water	0·9	0·4	0·6	—
Minor constituents	0·6	0·3	0·1	—
	100·0	100·0	100·0	100·5

MASSIVE ROCKS.

	Feldspar-porphyrite.	*Augite-porphyrite.*	*Hornblende-porphyrite.*	*Hornblende-porphyrite.*
	Essequibo River.	Cuyuni River.	Barama River.	Mazaruni River.
Quartz	34·1	16·7	13·5	19·9
Orthoclase	—	2·8	1·1	7·8
Labradorite (Ab_1 An_1)	—	—	—	36·9
Labradorite (Ab_1 An_2)	—	—	34·7	—
Oligoclase (Ab_2 An_1)	51·0	56·1	—	—
Biotite	2·2	—	—	—
Augite	—	19·7	—	—
Hornblende...	11·2	—	50·5	33·8
Magnetite	—	2·3	—	—
Ilmenite	0·8	0·5	0·1	0·9
Apatite	0·3	—	—	—
Calcite	0·9	—	—	—
Water	0·6	—	0·1	0·7
Minor constituents	—	1·9	—	—
	101·1	100·0	100·0	100·0

SCHISTOSE ROCKS.

	Quartz-porphyrite-schist.	*Feldspar-porphyrite.*	*Chloritoid-schist.*	*Sericite-schist.*	
	Essequibo River.	Essequibo River.	Potaro River.	Barama River.	Cuyuni River.
Quartz	55·4	52·4	71·4	62·7	54·4
Orthoclase	—	—	—	6·1	—
Albite	12·6	—	—	—	—
Labradorite (Ab_2 An_5)	—	22·2	—	—	—
Bytownite (Ab_1 An_3)	—	—	2·7	—	—
Sericite	7·3	4·0	0·1	31·0	42·6
Hornblende	12·0	13·8	—	—	—
Chlorite	1·8	1·8	—	—	—
Chloritoid	—	—	18·8	—	—
Diaspore	6 6	3·6	7·9	—	—
Hematite	—	—	—	—	2·5
Ilmenite	—	—	—	0·2	—
Magnetite	2·2	1·6	0·7	0·2	0·9
Sphene	—	0·8	—	—	—
Apatite	0·2	—	0·4	—	—
Calcite	3·6	0·5	—	—	—
Magnesite	0·6	—	—	—	—
	102·3	100·7	102·0	100·2	100·4

Schistose Rocks.

	Hornblende-chlorite-schist.		*Chlorite-schist.*
	Arakaka.	Lower Barama.	Mazaruni.
Quartz	18·0	19·8	21·2
Labradorite (Ab_1 An_1)	—	45·7	—
Labradorite (Ab_2 An_3)	30·8	—	—
Sericite	0·3	3·3	10·9
Bytownite (Ab_1 An_3)	—	—	38·9
Hornblende	15·3	5·2	—
Chlorite	28·3	17·5	17·2
Limonite	—	—	4·8
Ilmenite	0·8	0·4	0·8
Apatite	0·1	—	—
Calcite	6·2	8·0	5·7
	99·8	99·9	99·5

The massive rocks may be classified according to their ultimate magmatic compositions as follows :—

Quartz-porphyry	Alaskose.
Granophyre	Dacose.
Quartz-porphyrite	Sitkose.
Feldspar-porphyrite, Cuyuni River	Lassenose.
,, ,, Essequibo River	Varangose.
Augite-porphyrite	Dacose.
Hornblende-porphyrite, Barama River	Placerose.
,, ,, Mazaruni River	Tonalose.

By comparison of the compositions of the two classes of the schists in the Essequibo-Potaro district, with the compositions of the quartz-porphyrite, of the granophyre, and of the feldspar-porphyrite from the same district, it is clear that the metamorphic changes have resulted in the decomposition of the feldspar, so as to liberate quartz or silica, and possibly some alumina, much of the latter remaining in the altered rock in the form of kaolin, or as diaspore, the minute flakes of which are confused under the microscope with sericite—which resulted from the alteration of the orthoclase—the removal of a good deal of the lime of the feldspars as calcite, and the change of the pyroxenes and other ferro-magnesian minerals into hornblende and chlorite, this being accompanied by the extrusion of magnetite. In places the metamorphism results in the production of quartz-schists and of so-called jasper.

In the schistose rock it is noticeable that the metamorphism, while converting the feldspar of the groundmass into sericite or other hydrous micas and into quartz, has produced little effect upon the phenocrysts of quartz, few only of which are fractured or show faint strain-shadows. Similarly, the feldspar-phenocrysts have suffered less alteration than has the feldspar of the groundmass.

The fact that the massive rocks of this group changed more or less gradually into schistose ones was noticed during the examination of the North-Western district in 1897; whilst the gradual transition through the stage of porphyroids of some of the varieties into schists was proved by the field-examinations of the Essequibo-Potaro district, and the laboratory studies of the rocks collected during the expeditions in the years 1898 and 1899. But the origin of the rocks remained obscure until they were studied in the upper parts of the Cuyuni and of the Berbice River in 1904 and 1905. In the Cuyuni district, at Topekai Rapids, near St. John's landing, at Waikuri Rapids, and near the mouth of the Wenamu Creek, feldspar-porphyrites and augite-porphyrites were found having a more or less well-marked andesitic groundmass, while in the Berbice River district, at Itabru Gate and Itabru Cataracts, quartz-porphyry occurs, showing very clearly a fluxion-structure, and containing a good deal of glass in the base. At Little Itabru Rapid and at Manmakuri Rapids, a feldspar-porphyrite of similar structure and composition was found, while at Winter's Fall and at Tramway Rapid, biotite-feldspar-porphyrite occurs, showing in thin slices a well-marked fluxion-structure.

Near Anaripia and Pigeon Island, in the Cuyuni River, feldspathic tuffs were found, while in the Berbice River, between Ariwa and Deringbang, and near Umbrella Fall, fairly well-marked tuffs occur, and it is doubtful whether others of the rocks of this group collected on this river are consolidated tuffs or are altered rhyolites. Much altered tuffs have also been found on the Demerara and Pomeroon Rivers. The porphyries and porphyrites and the schistose rocks derived from them probably are therefore altered rhyolites and andesites and their deeper-seated representatives. Some of them may have been thin and narrow lava-flows, but the majority appear to be portions of very widely spread thick sheets of rhyolite and andesite. It is also probable that the zoisite-hornblende-schists at and near Popekai Rapids in the Cuyuni River, which have been described under the amphibolite and hornblende-schist group, were originally parts of similar flows of basic hornblende-andesites. If this view is correct, and the field-evidence is in favour of it, the porphyries and porphyrites and their allied schists are representatives of hypabyssal and of volcanic rocks varying from acidic rhyolites to basic andesites.

CHAPTER VIII.

THE PETROGRAPHY OF THE GRANITIC ROCKS.

THE rocks of this type occurring in the colony are aplite, muscovite-granite, granite, granitite, hornblende-granitite, augite-granitite, quartz-diorite, quartz-mica-diorite, diorite, syenite, augite-syenite, mica-gabbro, gabbro and norite.

These show to a greater or less extent a gneissose structure, their component minerals in places exhibiting strain-effects.

Aplite and Muscovite-granite.—The veins of granitic rocks, which in many places traverse the basal complex of British Guiana, are more frequently aplite or muscovite-granite than true granite or granitite; for in them ferro-magnesian minerals are present in only very small proportions to the quartz and feldspar, or in many cases are practically absent. Rocks of this nature have been found in every part of the colony I have examined; they appear to be more abundant in the lower reaches of the Cuyuni River than elsewhere.

Aplite.—Rocks of this class usually vary in colour from white or pinkish-white to pinkish-red, but some are of various shades of grey. They vary in specific gravity from 2·59 to 2·68. In hand-specimens some of them show blebs of quartz and crystals of feldspar, while others are uniformly fine-grained. In a few specimens small crystals of red and of black garnet (melanite) have been found. Under the microscope the aplites are seen to be granitic aggregates of plates of orthoclase, microline, albite, some of oligoclase and irregular areas of quartz, whilst in places they contain small quantities of quartz and feldspar in micro-pegmatitic relationship to one another. Minute granules of crystals of epidote or of zoisite, and leaves and flakes of sericite, are occasionally present in the feldspar. Many specimens of the aplites are practically free from mica, but a few small flakes of brown to greenish-brown biotite, of chlorite after biotite, and of muscovite, are present in some of them in unimportant quantities. Minute grains of magnetite, of titaniferous iron-ore with leucoxene, and of sphene, and very minute prisms of apatite and of zircon, are present in exceedingly small proportions as accessories. In some parts the quartz shows strain-shadows, and the lamellæ of some of the feldspars are bent or broken. The aplites frequently are traversed by very thin veins of epidote. An aplite from Sapira Cataracts on the Mazaruni River contains, in addition to feldspar and quartz, blebs and patches of colourless glass, containing many microliths. The glass in places has eaten into the feldspar.

Muscovite-granite.—Wherever this occurs it is a fine-grained white rock of specific gravity varying from 2·59 to 2·66. It is composed of an irregular granitic aggregate of orthoclase, microcline, albite, some oligoclase and quartz, with flakes of muscovite, most of the mica being original, but some of it secondary from biotite; in some specimens scattered flakes of sericite are found. In some parts of this rock the lamellæ of muscovite are bent, whilst plates of feldspar and patches of quartz show strain-shadows.

With the exceptions of the aplite and the muscovite-granite of the Mazaruni River district, which yielded to assay four grains of gold per ton of the rock in the colony, these rocks, where unaltered, are free from the precious metals; but certain altered aplites are more or less auriferous, especially, as will be described later, the altered aplite of Omai, Essequibo River.

Granite.—The largest development of true granite in the parts of the colony I have visited is the mass at the junctions of the Mazaruni, Cuyuni and Essequibo rivers. Granite occurs also on the lower parts of the Waini River, on the Pomeroon River and on the Kuribrong River.

These granites vary in specific gravity from 2·59 to 2·62. They are grey in colour, and are usually medium to fine-textured rocks, but those on the Waini and Pomeroon rivers are coarse-textured. They contain relatively large irregular plates of orthoclase-feldspar in places with included blebs of albite, many smaller plates of microcline and somewhat abundant ones of oligoclase,—the feldspars contain some inclusions of small granules of epidote and minute flakes of secondary muscovite, and irregular patches of quartz, which, in some specimens, show faint to marked strain-shadows, whilst others are free from them.

The micas present are in the forms of large plates of muscovite and flakes and wisps of greenish biotite—the relative proportion of muscovite and biotite varying in specimens from different places. The plates of muscovite in the granites from the Waini and Pomeroon rivers show markedly the effects of strain, being in places much distorted, and stretched into large streams of smaller plates, which traverse lines of fracture in the granite. The biotite in them is of the type usually present in gneissose granites. A few grains of sphene, rarely minute crystals of zircon and some granules of iron-ore are sparsely present.

Granitite.—The varieties of granitite have been studied with the following results:—

(*a*) *Grey Granitite.*—This is usually very coarse-textured, in places with the development of large porphyritic crystals of orthoclase, or less commonly of oligoclase. It ranges in specific gravity from 2·61 to 2·74, according to the proportion of biotite it contains.

Under the microscope it is seen to be made up of large plates of orthoclase, some of which contain flakes of muscovite, while others are clouded with sericite, or are much saussuritised. Some of the plates show a microperthitic structure and enclose patches or blebs of albite or of quartz. In parts large plates of microcline occur in place of orthoclase. Oligoclase occurs in quantity in plates of very varying sizes, which not unfrequently contain inclusions of minute prisms of epidote

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VI.—i.

GRANITITE, × 12,
PENAL SETTLEMENT, MAZARUNI RIVER.

Photo by J. Williams.

ii.

HORNBLENDE GRANITITE, × 30,
AKAWAIO, CUYUNI RIVER.

Photo by J. Williams.

and flakes of sericite. Here and there the plagioclase shows twinning of the pericline type. In some specimens the lamellæ of the feldspar are bent, curved, or even broken.

Microcline is present in most of the specimens I have examined, usually in irregular areas of later consolidation than the remaining feldspars and the quartz. Quartz occurs in very varying proportions, it is rarely idiomorphic, and generally forms irregular areas, the majority of which show, to a greater or less extent, strain-shadows, whilst patches occur having a granular structure.

Green, dark-olive-green, and brown biotite is found in very varying proportions in ragged-edged plates and aggregates associated with small granules of epidote, while the latter also occurs in isolated granules and patches. In some specimens irregular patches of chlorite secondary to biotite are noticeable. In places a few flakes of muscovite sparsely occur, generally intergrown with the biotite. Among the rarer and more sparsely distributed constituents are found minute grains of magnetite and of titaniferous iron-ore with leucoxene, small grains, granules and crystals of sphene, small blebs of garnet, a few minute crystals of zircon, and some small prisms of apatite.

(*b*) *Pink to red Granitite.*—This variety is, as a rule, finer in texture than are the majority of the grey ones, but in places—for instance, at Maripa in the Mazaruni River—it is very coarse-textured. It is of various shades of pink to red in colour, whilst hand-specimens of the darker varieties show the presence of black mica in abundance. It ranges in specific gravity from 2·60 to 2·79, the lighter kinds generally occurring in relatively narrow veins, the heavier in extensive masses. As in the case of the grey granitite the specific gravity varies with the proportions of biotite the rock contains. In composition it is similar to the grey variety, but orthoclase is usually more abundant and oligoclase less evident in it than they are in the latter. Its red colour is due to the red-coloured crystals of orthoclase it contains.

(*c*) *Hornblende-granitite.*—The hornblende-granitites are usually pink or reddish rocks with not infrequently patches of green to greenish-grey, whilst in many of them the ferro-magnesian constituents are very conspicuous. The hornblende-granitites vary in specific gravity from 2·68 to 2·86, the majority of them falling between 2·73 and 2·78. They closely resemble in composition the granitites, but contain, in addition to biotite, hornblende in greater or less abundance; the mineral being usually of a green colour, but in some places pale-blue or, very rarely, brown. The hornblende is, as a rule, principally present in aggregates with biotite, some granular epidote, and not infrequently with crystals of sphene. The accessory minerals—magnetite, titaniferous iron ore, sphene, zircon, and apatite—although never present in more than unimportant quantities are, as a rule, more abundant in the hornblende-granitites than they are in the granitites.

(*d*) *Augite-granitite.*—Some granitites, as, for instance, rocks from Kusawe and from Kartauari Cataracts in the Mazaruni River, contain augite in small quantities, usually in aggregates with brown biotite, but in the Black Creek branch of the Groete Creek in the Lower Essequibo River a rock occurs which is a granitite having augite as the most abundant ferro-magnesian mineral. It is of medium texture and dark-purple in colour. Its specific gravity varies from 2·73 to 2·81. The rock is composed of plates of varying size of orthoclase, the twinning planes of which are frequently bent or curved, plates of oligoclase also of very varying size with the lamellæ frequently bent or broken, the relative proportions of the two feldspars varying greatly in different parts of the rock; small patches of microcline are seen in some specimens, whilst micropegmatite is of somewhat rare occurrence, and small irregular patches of quartz occur which show strain-shadows. The ferro-magnesian constituents consist of large patches of very pale, almost colourless, augite, usually with numerous extruded grains of magnetite lying in parallel streaks in the crystals, which in places are changed to green hornblende; abundant to very abundant plates of dark-brown biotite with well-marked haloes of deeper colour surrounding inclusions of minute crystals of zircon, the lamellæ of the biotite in places curving round masses of augite, and in others being bent or broken; some plates of original pale-blue hornblende, and a little granular epidote. In some parts of the rock small crystals of zircon are relatively abundant, in others are comparatively rare, whilst prisms of apatite are occasionally found. Part of the pyroxene of these rocks was originally hypersthene.

There is a gradual transition among the granitic rocks from aplite, through granite and granitite, to rocks approximating in composition to syenite and to diorite.

Basic Secretions in the Granitites—In certain of the masses of the granitites segregation-patches occur which are of much darker colour and of higher specific gravity than the bulk of the rock. The patches are, as a rule, of finer grain and closer texture than the rock from which they have segregated. They consist of plates of oligoclase with inclusions of sericite and epidote, some plates of orthoclase, and a few patches of microcline; irregular areas of quartz, many of which show strain-shadows; many plates of brown biotite, some of chlorite secondary to biotite, and many of green hornblende, with some granules of epidote. Many crystals and some grains of sphene, with grains and minute crystals of magnetite, and of titaniferous iron ore, and a few small prisms of apatite are present as accessories. These basic secretions approach in composition to quartz-mica-diorite.

VII.—i.

AUGITE GRANITITE, × 18,
BLACK CREEK, GROETE CREEK.

Photo by J. Williams.

ii.

TONALITE, × 18,
CABURI, MAZARUNI RIVER.

Photo by J. Williams.

Inclusions in the Granitites—In many places the granitite contains masses, varying much in size, of the gneissose rocks through which it has been intruded; these in no way differ in structure and in composition from the rocks they have been derived from.

In places, as at Kartabo on the Cuyuni River, masses occur in the granitite which appear to have been derived from clastic rocks. The rock at Kartabo is coarse-textured, and shows in all parts I have examined a more or less laminated structure. Its specific gravity is 2·76. It is made up of a microcrystalline mosaic of quartz, with some plates of water-clear feldspar, and a few showing plagioclastic markings; traversed by streams of green hornblende lying approximately parallel in their long diameters to one another. A few grains of epidote are also present, and in parts some grains of magnetite are found.

Quartz-mica-diorite.—This rock occurs in relatively narrow dykes and veins traversing the gneiss. It is a dark grey, usually medium to fine-grained rock, but in places becomes coarse-textured; its specific gravity varies from 2·81 to 2·94. It is made up of granular to granitic aggregates of plagioclase, principally labradorite, with a few small patches of quartz, in places showing strain-shadows, or, in some specimens being granulitic. Many of the feldspar plates are crowded with minute prisms of epidote, or of zoisite, with a little sericite. The rock contains in abundance large plates and wisps of light-brown biotite, in places changed to chlorite, many irregularly shaped plates of hornblende varying in colour in different specimens from pale-blue, green, or olive-green, to light-brown, some of the paler ones with many extruded grains of magnetite, a few plates of a colourless augite, and some granules and aggregates of epidote. Small grains of magnetite, of titaniferous iron ore, and of sphene, with minute prisms of apatite, which in some specimens are only sparsely distributed, but in others are relatively abundant, form accessories.

Quartz-diorite.—This occurs under similar conditions to those in which the foregoing rock does; and the two are very closely related. The quartz-diorites are grey to dark-grey in colour, fine to somewhat coarse-grained in texture, and vary in specific gravity from 2·80 to 2·96. They are granular to granitic aggregates of plates of a basic labradorite, usually crowded with minute grains of epidote, of zoisite, and with some flakes of sericite, irregularly bounded areas of interstitial quartz, with more or less idiomorphic plates of varying sizes of green and of brown hornblende. Some of the plates of hornblende have a poikilitic structure. In certain specimens the hornblende is either very pale-green or pale-blue in colour, the plates are ragged-edged, in places contain some minute grains of extruded magnetite, and they are accompanied by small aggregates of chlorite, and granules of epidote. In a few specimens pale-brown biotite in flakes, and small plates of colourless augite are sparsely found. The accessory minerals occur in very varying proportions, and consist of sphene in granules or in crystals, small grains of magnetite and of titaniferous iron ore, in places with leucoxene, occasionally a few blebs of garnet, and small prisms of apatite, which are usually sparsely distributed but are present in some specimens in relative abundance. Small crystals of pyrite, and plates of carbonates are present in parts of the rock as secondary constituents.

Diorite.—Diorite, other than as local modifications of the granitic masses, is of somewhat rare occurrence in British Guiana. Hornblende-plagioclase rocks not infrequently occur, but examination of thin slices show that the great majority of them are amphibolised diabase or gabbro. The true diorites occur, as a rule, in narrow dykes and tongues intrusive through the gneiss.

They are dark-grey rocks, occasionally of coarse texture, but, as a rule, fine-grained, and they vary in specific gravity from 2·85 to 3·07. The majority of them are granitic aggregates of a basic labradorite, in laths and in more or less idiomorphic plates, some showing a zonal structure, and usually containing more or less epidote and sericite ; a very little interstitial quartz ; and abundant masses of green, olive-green, or pale-brown hornblende, in places containing some small extruded grains of magnetite, with a few granules of epidote. In some specimens small kernels of pyroxene are recognisable in the masses of hornblende.

In a few specimens the hornblende is pale-blue, and has a poikilitic to an ophitic structure; the labradorite being in laths, and here and there in small phenocrysts.

The accessory minerals in the diorite are the same as those found in the quartz-diorites, and are similarly irregularly distributed.

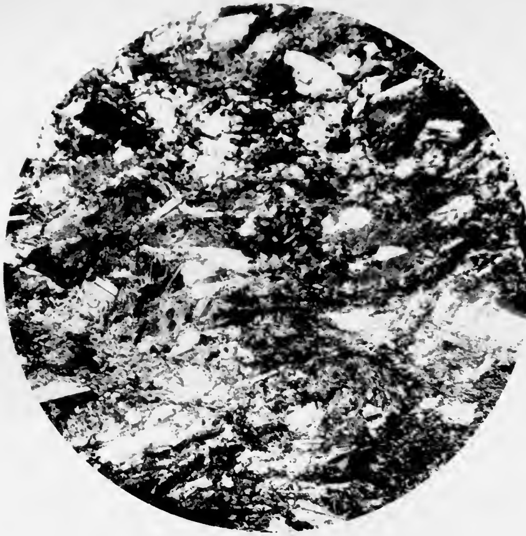
A small island a little below Sapira Cataracts in the Mazaruni River, is made up of a porphyritic rock containing very abundant large crystals of hornblende in a scanty matrix of feldspar. Its specific gravity is 2·97. It contains large phenocrysts of green hornblende, with here and there prisms of epidote, some flakes of chloritised biotite, and a few scattered grains of magnetite set in a holocrystalline matrix of a basic labradorite clouded with sericite, and, with here and there, a few granules of secondary quartz.

In the Sororieng Channel of the Mazaruni River, a dark-grey rock of medium texture, and having a specific gravity of 2·89, occurs. It is made up of large phenocrysts of a colourless augite, with peripheral green hornblende, and in places with a little chlorite, some of the phenocrysts showing many extruded grains of magnetite ; some plates of dark olive-green to brown original hornblende, and some flakes of brown biotite; abundant laths of labradorite with corroded edges and with many included small prisms of zoisite, the feldspar being in places more or less sericitised ; a little interstitial quartz; and some scattered grains of magnetite. This rock is an augite-diorite.

Syenite.—Of even rarer occurrence than the true diorites are the syenites. I have found two kinds of these,—true syenite or hornblende-syenite, and augite-syenite. The only mass of the former I have seen is at Pigeon Island in the Lower Essequibo River. It is a medium to coarse-textured granitic rock, with conspicuous crystals of hornblende in a feldspathic matrix, and it has a specific gravity of 2·85. Under

[To face page 72.

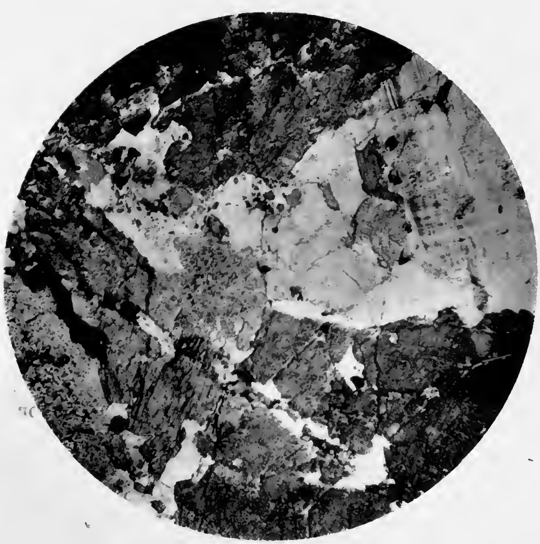
VIII.—i.



DIORITE, × 12,
WITH VEIN OF GRANITITE,
MUTOSSE, CUYUNI RIVER.

Photo by J. Williams.

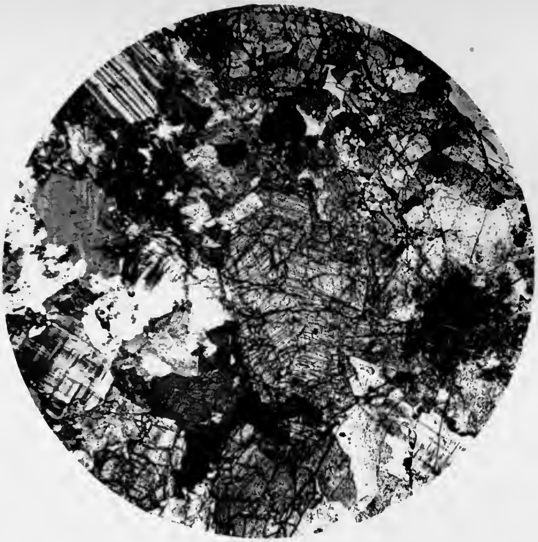
ii.



HORNBLENDE SYENITE, × 12,
PIGEON ISLAND, ESSEQUIBO RIVER.

Photo by J. Williams.

IX. -i.



AUGITE SYENITE, × 18,
MAKARI, MAZARUNI RIVER.

Photo by J. Williams.

ii.

NORITE, × 12,
TAMUTAN, RUPUNUNI-TAKUTU WATERSHED.

Photo by J. Williams.

the microscope it is seen to be made up of large, irregular plates of orthoclase, of microcline, and some of oligoclase, a few of the latter are crowded with microliths of epidote; with a very little quartz; and many large, more or less idiomorphic plates of green hornblende. A few blebs of garnet, some small crystals and granules of sphene, and a little limonite are unimportant accessories.

Augite-syenite.—Augite-syenite, more or less altered, occurs in a broad belt at the Makari Rapids, and in a narrow dyke at the Caburi Cataracts on the Mazaruni River. The Makari rock consists of a porphyritic variety with large phenocrysts of orthoclase, some of which are one and a half inches in length; and with some smaller ones of a pale brown pyroxene thickly scattered through a white matrix, in which, here and there, are tufts of small yellow crystals of a mineral which probably is epidote. The mass of the Makari belt and of the dyke at Caburi are of a compact rock of similar composition. Its specific gravity varies from 2·67 to 2·78. In thin slices the rocks are seen to be made up of large plates of orthoclase, smaller ones of microcline, and some of plagioclase with bent lamellæ; large patches, and more or less fractured idiomorphic crystals of a colourless pyroxene, probably an augite, with, in places, streams of crystalline plates of clinozoisite with some of epidote. The pyroxene crystals frequently are bordered with epidote, and a little sphene is also present. In places tufts of radiating microliths interpenetrate the alkali-feldspars from the patches of clinozoisite.

A dyke of a very basic syenite of about thirty feet in breadth traverses hornblende-granitite-gneiss in the Teboco channel of the Mazaruni River. It is very coarse-textured; the inner parts of the dyke consist of abundant, short, broad phenocrysts of dark-coloured hornblende, some being from a quarter to half an inch across lying in a compact light grey matrix, whilst in the outer parts, near the junction of the dyke with the gneiss, the crystals of hornblende, there very abundant, are relatively long and narrow. In places near its margins the rock is traversed by thin veins of epidote and zoisite. Its specific gravity varies from 2·89 to 3·01, being highest near the edges of the dyke. Under the microscope the rock is seen to consist of idiomorphic crystals of green and brown hornblende, containing in places irregularly bounded plates of a colourless augite, with some irregular masses of the same mineral lying in a matrix of alkali-feldspar —which in places shows the characteristics of microcline—and some quartz. Near its margin the rock of the dyke contains many grains of magnetite, some of which occur in the matrix, while others are included in plates of hornblende. It is traversed by veins of epidote, and here and there contains small quantities of scattered granules and aggregates of epidote with some zoisite. Quartz in small, irregularly sloped patches, which are clearly of secondary origin, frequently occurs in the rock.

The rock is a basic augite-hornblende-syenite.

Mica-gabbro.—In many places in the Mazaruni River, and in parts of the Pomeroon River, great masses of a very coarse-grained diabase or fine-grained gabbro occur. The rock differs from the later intrusive diabase by containing a good deal of dark-brown mica. It is more or less granitic in structure, and the augite masses are frequently bordered by uralitic hornblende, while the feldspars show strain-effects. Under the microscope it is seen to be made up of large, broad laths and plates of labradorite, showing in places commencing saussuritisation and in others strain-effects, and with many needle-like prisms of zoisite included in it; large masses of almost colourless augite showing in places schiller-structure, and partially converted on their peripheries into uralitic hornblende, this change being accompanied in places by the extrusion of abundant small grains of magnetite; many plates of dark-brown biotite; a few sparse granules of olivine, abundant granules of titaniferous iron-ore and some scattered minute prisms of apatite.

In order to examine the minerals present in samples of this rock from the Mazaruni River, which are not attacked by acids, about 200 grams of it was coarsely powdered and digested in successive quantities of a mixture of hydrochloric and hydrofluoric acids until all action ceased. The residue was treated with a warm dilute solution of caustic soda, and the undissolved portion was digested with a mixture of hydrofluoric and dilute sulphuric acids. The minute amount of matter which resisted this treatment consisted of minute grains of zircon, and of a few pale-violet, and many nearly to quite colourless octahedral crystals. These crystals are all of very high refractive power, the great majority of them consisting of spinel, whilst some are perofskite. A very few minute ones resisted the action of boiling strong sulphuric acid, and are of very high refractive power, and thus probably are diamonds. The largest of these is less than one five-hundredth of an inch across.

Gabbro.—Near the Kuruduni Creek in the Berbice River, near the Cabalebo Creek in the Corentyn River, and in several places on the Ireng, Upper Mazaruni, and Cotinga Rivers, somewhat fine-grained gabbro occurs. Its specific gravity varies from 2·95 to 3·05. The rock is a granitic aggregate of masses of nearly colourless augite, frequently showing diallagic markings, and in places changed peripherally into uralitic hornblende, some of the pyroxenes are traversed by cracks, and are more or less altered into serpentine; of some flakes of brown biotite; and of large plates of more or less idiomorphic labradorite, which here and there show the effects of strain. In parts the feldspars have been changed into areas of confused crystalline aggregates, or are much saussuritised. Small areas of a rather coarse-textured micro-pegmatite of quartz and feldspar, with a few small irregular patches of quartz, are found in it. As subordinate constituents, a few relatively large, irregularly shaped granules of titaniferous iron-ore and of magnetite, some small prisms of apatite, and microlithes of zoisite, epidote and hornblende occur.

Norite.—At Tamutan Hill, near the Takatu River, and near Sirkirtun in the Canucu Mountains, rocks of gabbro-type occur which contain large proportions of hypersthene and are norites. They are moderately coarse-grained; and are made up of large rounded areas of hypersthene, with others of a pale to almost colourless augite in parts, in part changed to a brownish one, with, in places, smaller masses of olive-green hornblende; large, irregular, more or less rounded plates of labradorite which here and there interpenetrate the pyroxene masses, and in places show strain-effects; and a very few granules of magnetite.

Mica-norite.—A fairly coarse-grained, dark-grey rock, which occurs near Hiari Rapids in the Aranamai Creek of the Pomeroon River consists of large plates of labradorite, some showing strain-effects, their lamellæ being bent and parts of them changed into more or less granulated areas of water-clear feldspar; large irregularly bounded crystals of pyroxene, some of which consist of a nearly colourless augite, whilst most of them are of a pink enstatite or bronzite; in a few cases the peripheries of the masses of pyroxene are more or less altered to pale-green hornblende with the extrusion of minute grains of magnetite, whilst some of the crystals of enstatite contain inclusions of, or are in parts changed to brown biotite; numerous aggregates of plates of dark-brown biotite in places, surrounding to various extents the masses of enstatite and some irregular granules of titaniferous iron-ore.

Elvans in the Granitites.—Some of the masses of granitite are traversed by relatively narrow veins of micro-granite and of felsite.

The micro-granites vary in colour from light-grey, nearly white, to dark-green, are compact in texture, and have specific gravities ranging from 2·65 to 2·74. They consist of a micro-crystalline to micro-granitic groundmass of feldspar and quartz, with some granular epidote, some chlorite and a little sericite; containing from few to numerous small phenocrysts and a few larger rounded blebs of quartz showing uniform extinction; and some large and many small phenocrysts of orthoclase and plagioclase. Where the groundmass is micro-crystalline, the small feldspar-laths generally have corroded outlines. As unimportant accessories the rock contains small laths of biotite, and of chlorite after biotite, a few crystals of apatite and some grains of magnetite, of titaniferous iron-ore and of sphene.

The felsite consists of small rounded grains of quartz and very small plates of augite in a crypto-crystalline aggregate of feldspar, augite, and epidote, with very minute grains of magnetite. The rock is dark-coloured, almost black, and under the microscope shows fluxion-structure.

At Yakiri Creek, on the right bank of the Barima River, where it is crossed by the portage, there is an intrusive dyke in granite. The middle part is fine-grained and massive, the outer parts, in contact with or close to the granite, being foliated. The schistosity arises from parallelism in the arrangement of the biotite and the hornblende present in the rock, and is due to fluxion in the pasty mass during its intrusion into the granitite. The rock is of specific gravity 2·84, and consists of a very fine-grained micro-crystalline aggregate of feldspar with some quartz; in which are abundant biotite and hornblende crystals lying in approximately parallel bands with a few small granules of epidote.

The chemical compositions of the Aplite, Granite, Granitite, Syenite, Diorite, and Gabbro are shown by the following analysis:—

	Aplite.			*Granite.*	*Granitite.*
	Barima River.	Sapira Cataracts, Mazaruni River.	Essequibo River.	Mazaruni River.	North-Western District.
Silica	77·58	74·15	75·88	73·81	68·40
Alumina	13·96	10·07	14·75	13·93	13·59
Iron peroxide	0·54	0·86	trace	0·93	1·32
Iron protoxide	0·45	—	trace	0·46	2·41
Magnesium oxide	0·30	0·30	0·16	0·72	1·26
Calcium oxide	0·83	1·28	2·08	0·88	2·34
Sodium oxide	4·97	6·34	3·78	2·80	3·89
Potassium oxide	0·90	4·44	2·60	4·81	4·24
Water	0·20	0·71	0·20	0·74	0·85
Carbonic anhydride	—	—	—	trace	—
Titanium oxide	0·40	0·93	0·50	0·62	1·10
Zirconium	—	—	—	trace	trace
Phosphoric anhydride	trace	0·09	trace	0·06	trace
Chlorine	trace	0·13	trace	0·02	0·03
Iron sulphide	—	0·004	0·002	0·02	—
Cobalt oxide	—	—	—	0·28	—
Manganese oxide	0·30	0·26	0·04	0·24	0·20
Barium oxide	—	0·04	—	0·01	0·36
Copper oxide	—	0·06	—	trace	—
	100·43	99·664	99·992	100·33	99·99

	Granitite.		*Hornblende-granitite.*		
	Mazaruni River.	Essequibo-Potaro District.	Barama River.	Mazaruni-Purini River.	Essequibo-Potaro River.
Silica	65·88	72·49	67·88	62·16	68·20
Alumina	15·61	15·82	17·21	16·12	15·83
Iron peroxide	2·42	1·18	2·00	3·39	2·86
Iron protoxide	2·71	0·15	1·62	1·85	0·51
Magnesium oxide...	1·76	0·76	1·52	2·93	2·14
Calcium oxide	3·70	2·02	3·08	4·59	3·49
Sodium oxide	3·92	4·03	5·71	5·20	3·07
Potassium oxide	2·29	2·26	0·26	2·29	2·88
Water	1·05	0·35	0·45	1·12	0·50
Carbonic anhydride	trace	0·14	—	trace	0·06
Titanium oxide	0·43	0·56	0·20	0·23	0·46
Zirconium oxide	trace	trace	trace	trace	trace
Phosphoric anhydride	0·13	0·008	0·10	0·16	0·01
Chlorine	0·02	trace	trace	0·02	trace
Iron sulphide	trace	—	—	trace	0·01
Cobalt oxide	—	—	—	0·01	—
Manganese oxide	0·08	0·05	0·09	0·20	0·08
Barium oxide	—	—	—	0·07	—
Copper oxide	trace	—	—	0·02	trace
	100·00	99·818	100·12	100·36	100·10

	Augite-granitite.		*Augite-syenite.*		*Syenite.*
	Mazaruni River.	Groete Creek.	Demerara River.	Mazaruni River.	Pigeon Island, Essequibo River.
Silica	67·23	61·55	62·95	59·33	55·58
Alumina	14·70	14·01	20·81	20·46	12·41
Iron peroxide	2·85	0·37	1·73	1·66	0·59
Iron protoxide	1·15	7·27	0·39	0·22	6·70
Magnesium oxide...	1·39	5·26	2·66	0·83	10·93
Calcium oxide	2·91	4·80	3·75	7·09	7·95
Sodium oxide	6·89	2·29	4·15	2·58	1·01
Potassium oxide	1·70	2·52	3·46	7·03	2·96
Water	0·79	0·45	0·20	0·36	0·64
Carbonic anhydride	trace	0·19	0·02	trace	—
Titanium oxide	0·08	0·28	trace	0·10	0·56
Zirconium	—	0·01	—	—	—
Phosphoric anhydride	trace	0·02	0·09	0·05	0·03
Chlorine	0·02	0·05	trace	0·06	0·09
Iron sulphide	0·02	—	0·005	0·02	—
Cobalt oxide	—	—	—	0·01	—
Manganese oxide	0·12	0·46	—	0·16	0·50
Barium oxide	—	0·61	trace	—	0·16
Copper oxide	0·04	—	—	0·05	—
Lead oxide	—	—	—	0·01	—
	99·89	100·14	100·215	100·02	100·11

	Quartz-mica-diorite.		*Quartz-diorite.*		*Diorite.*
	North-Western District.	Mazaruni River.	Essequibo River.		Barima River.
Silica	61·12	56·63	60·35	60·96	52·16
Alumina	16·23	17·01	18·71	18·06	14·72
Iron peroxide	1·76	6·15	2·10	1·42	4·11
Iron protoxide	3·68	2·80	2·15	2·48	7·18
Magnesium oxide	7·05	4·08	4·08	5·09	9·44
Calcium oxide	4·83	6·83	7·18	6·67	8·44
Sodium oxide	3·01	4·48	1·54	2·39	1·49
Potassium oxide	0·97	0·25	0·32	0·28	0·32
Water	0·41	1·17	1·50	1·26	1·06
Carbonic anhydride	—	0·02	0·08	0·04	trace
Titanium oxide	0·48	0·18	0·70	1·10	0·42
Zirconium	—	trace.	—	—	—
Phosphoric anhydride	0·08	0·28	0·29	0·246	0·06
Chlorine	—	0·06	trace	trace	trace
Iron sulphide	0·11	—	0·005	0·004	0·29
Manganese oxide	trace.	0·05	0·66	0·34	0·48
Barium oxide	—	—	trace	trace	—
Copper oxide	—	0·04	trace	trace	trace
	99·73	100·03	99·665	100·340	99·86

	Porphyritic-augite-hornblende-syenite.	*Porphyritic-diorite.*	*Mica-gabbro.*
	Mazaruni River.	Sam Island, Mazaruni River.	Mazaruni River.
Silica	50·80	51·50	52·20
Alumina	9·93	10 89	16·10
Iron peroxide	3·95	1·75	3 56
Iron protoxide	6·91	6·84	5·68
Magnesium oxide	12·13	13·91	6·70
Calcium oxide	10·17	10·19	8·58
Sodium oxide	2·77	1·18	2·40
Potassium oxide	1·52	0·24	0·89
Water	0·67	2·40	0·60
Carbonic anhydride	—	—	0·01
Titanium oxide	0·80	0·20	2·60
Phosphoric anhydride	trace	trace	0·37
Chlorine	0·06	0·11	trace
Iron sulphide	—	—	0 03
Manganese oxide...	0·45	trace	0·22
Barium oxide	0·18	0·65	—
Copper oxide	trace	trace	trace
Lead oxide	—	trace	—
	100·34	99·86	99·94

With the exception of the aplite and muscovite-granite of the Mazaruni River district, which yielded, upon assaying, at the rate of 4 grains of gold per ton of the rock, the aplite of the colony where not mineralised appears to be free from the precious metals. The granite yielded upon assay traces only of the metal; while I have not been able to detect any traces of gold in the granitite of the North-Western, of the Cuyuni, and of the Essequibo-Potaro River districts; although in bulk samples from the Mazaruni-Puruni district, I found it present at the rate of 5 grains of the metal to the ton of the rock. Only minute traces of gold were detected in the hornblende-granitite of the North-Western and of the Essequibo-Potaro district, while the hornblende-granitite of the Mazaruni-Puruni district yielded gold when assayed at the rate of 2 grains to the ton. The augite-granitite of the Mazaruni yielded gold at the rate of 3 grains, while that of the Groete Creek yielded only traces of the metal. These results are in accordance with the fact that the granitic districts in the colony are seldom, if ever, the sites of payable auriferous deposits.

The augite-syenite of the Demerara River did not show any trace of gold, while that of the Mazaruni River yielded gold at the rate of 6 grains. The porphyritic hornblende-augite-syenite yielded at the rate of 10 grains of gold and 54 grains of silver to the ton of the rock. The dioritic rocks usually yield, when assayed, small amounts of gold; the quartz-mica-diorite from the Mazaruni River yielding at the rate of 5 grains of the metal per ton of the rock, whilst the porphyritic-diorite from Sam Island yielded at the rate of 4 grains of gold and 48 grains of silver.

The mica-gabbro yielded at the rate of 13 grains of gold and 6 grains of silver per ton.

THE MINERALOGICAL COMPOSITIONS AND CLASSIFICATION.

The essential original minerals which are present in these rocks are as follows:—

Quartz, orthoclase, microcline, oligoclase, albite, muscovite, biotite, augite, hornblende, titaniferous iron-ore, magnetite, sphene, apatite, zircon, and, in one case only, glass. From the results of the chemical and microscopical examinations outlined in the preceding pages, the mineralogical compositions of the rocks have been calculated as follows:—

	Aplite.			*Granite.*
	Barima River.	Sapira Cataracts, Mazaruni River.	Essequibo River.	Mazaruni River.
Quartz	42·8	33·4	39·5	36·6
Orthoclase	—	25·0	10·1	20·6
Albite	23·6	27·0	—	3·7
Oligoclase (Ab_3 An_1)	22·2	—	—	23·4
Oligoclase (Ab_2 An_1)	—	—	40·5	—
Muscovite	7·5	—	7·5	9·6
Biotite	—	—	—	3·7
Augite	2·8	3·0	1·1	—
Magnetite	—	—	—	1·1
Ilmenite	0·7	0·6	—	0·3
Sphene	—	1·3	1·2	1·2
Apatite	—	0·3	—	0·1
Glass	—	8·8	—	—
Minor constituents	0·4	0·6	0·1	—
	100·0	100·0	100·0	100·3

	Granitite.		
	North-Western District.	Mazaruni River.	Essequibo-Potaro District.
Quartz	24·1	26·7	35·5
Orthoclase	21·7	9·4	3·9
Oligoclase (Ab_3 An_1)	38·8	—	—
Oligoclase (Ab_2 An_1)	—	50·5	40·2
Muscovite	—	—	11·8
Biotite	6·5	9·7	2·2
Hornblende	3·5	—	5·1
Magnetite	1·4	2·5	—
Ilmenite	—	0·7	—
Sphene	2·7	—	1·4
Apatite	—	0·4	—
Minor constituents	1·3	0·1	—
	100·0	100·0	100·1

	Hornblende-granitite.		
	Barama River.	Mazaruni-Puruni River.	Essequibo-Potaro River.
Quartz	26·6	10·5	29·5
Corundum	2·1	—	—
Orthoclase	—	1·7	15·5
Oligoclase (Ab_3 An_1)	57·7	54·0	—
Labradorite (Ab_1 An_1)	—	—	37·5
Biotite	2·8	20·1	3·3
Hornblende	10·5	13·3	12·7
Ilmenite	0·4	0·4	—
Sphene	—	—	1·2
Apatite	0·5	0·3	—
Minor constituents	—	—	0·3
	100·6	100·3	100·0

	Augite-granitite.		*Augite-syenite.*		*Syenite.*
	Mazaruni River.	Groete Creek.	Demerara River.	Mazaruni River.	Pigeon Island, Essequibo River.
Quartz	14·2	16·9	10·5	1·7	1·3
Orthoclase	6·1	10·0	20·6	41·1	17·8
Albite	43·0	—	—	—	—
Oligoclase (Ab_3 An_1)	18·8	—	—	—	—
Oligoclase (Ab_2 An_1)	—	—	44·3	—	—
Labradorite (Ab_3 An_5)	—	37·7	—	—	—
Labradorite (Ab_1 An_2)	—	—	—	44·5	—
Bytownite (Ab_1 An_3)	—	—	—	—	29·0
Biotite	7·3	9·3	—	—	—
Augite	7·9	24·3	24·4	11·7	—
Hornblende	—	—	—	—	49·5
Ilmenite	—	—	—	—	—
Magnetite	1·2	—	—	—	—
Sphene	0·2	0·8	—	0·2	1·4
Apatite	0·1	—	—	0·2	—
Calcite	—	0·5	—	—	—
Minor constituents	1·2	0·5	0·2	0·6	1·0
	100·0	100·0	100·0	100·0	100·0

	Quartz-mica-diorite.		*Quartz-diorite.*	*Diorite.*
	North-Western.	Mazaruni River.	Essequibo River.	Barima River.
Quartz	23·6	11·8	22·2	11·2
Orthoclase	—	—	—	—
Sericite	—	—	2·0	—
Albite	—	—	—	—
Labradorite (Ab_1 An_1)	38·4	63·3	—	—
Bytownite (Ab_2 An_3)	—	—	36·0	30·1
Biotite	11·5	2·6	—	4·0
Augite	—	—	—	—
Hornblende...	24·6	20·8	34·6	52·7
Ilmenite	0·9	0·6	2·1	0·8
Magnetite	—	—	2·1	—
Sphene	—	—	—	—
Apatite	0·2	0·7	0·5	0·3
Minor constituents	0·8	0·2	0·5	0·9
	100·0	100·0	100·0	100·0

	Porphyritic augite-hornblende-syenite.	*Porphyritic-diorite.*	*Mica-gabbro.*
	Mazaruni River.	Sam Island, Mazaruni River.	Mazaruni River.
Quartz	—	1·8	11·9
Orthoclase	8·3	—	—
Albite	14·1	—	—
Bytownite (Ab_1 An_3)	—	—	48·8
,, (Ab_1 An_4)	—	33·9	—
Biotite	—	—	10·3
Augite	—	—	18·0
Hornblende	69·9	61·2	—
Ilmenite	—	0·5	5·0
Magnetite	5·6	1·8	4·6
Sphene	0·8	—	—
Apatite	—	—	1·0
Minor constitutents	1·3	0·8	0·4
	100·0	100·0	100·0

The rocks may be classified according to their ultimate magmatic composition as follows :—

Aplite, Barima River ... ... Yukanose.
,, Mazaruni River ... ... Varingose.
,, Essequibo River ... ... Alsbachose.
Granite, Mazaruni River... ... ... Tehamose.

Granitite, North-Western district	Toscanose.
,, Mazaruni River	Alsbachose.
,, Essequibo-Potaro district	Yellowstonose.
Horneblende-granitite, Barama River	Mariposose.
,, ,, Mazaruni-Puruni River ...	Dacose.
,, ,, Essequibo-Potaro River ...	Yellowstonose.
Augite-granitite, Mazaruni River	Kallendose.
,, ,, Groete Creek	Harzose.
Augite-syenite, Demerara River	Yellowstonose.
,, ,, Mazaruni River	Mazarunose.
Syenite, Essequibo River	Auvergnose.
Quartz-mica-diorite, North-Western district	Tonalose.
,, ,, ,, Mazaruni River	Placerose.
Quartz-diorite, Essequibo River	Bandose.
Diorite, Barima River	Auvergnose.
Porphyritic augite-hornblende-syenite, Mazaruni River	,,
Porphyritic diorite, Mazaruni River	Kedebocase.
Mica-gabbro	Hessose.

CHAPTER IX.

THE PETROGRAPHY OF THE CLASTIC ROCKS, SANDSTONES AND CONGLOMERATES.

The great sandstone and conglomerate formation of the Guianas lies directly upon the older igneous rocks. In places the latter are porphyrites or quartz-porphyries, and in others granite or gneiss. In some districts high hills and low mountains rise through the sandstone. These consist of very coarse-grained diabase or of gabbro. The conglomerates and sandstones appear to have been laid down against the flanks of these hills.

The lowest beds of the formation consist of indurated feldspathic mudstones, shales, or grits, as in the Potaro near Amatuk, and near Takwari Mountain on the Essequibo River, or in certain districts—such as the Cuyuni above the mouth of the Akarabisi Creek—of breccias and pudding-stones made up of angular and of rounded pebbles of felsite and quartz-porphyry in a recemented feldspathic matrix. Similar rocks occupy wide areas in the neighbouring Dutch colony of Surinam, chiefly in the Upper Merowyne, and have been described by G. C. du Bois, in his work "Geologischbergmannische Skizzen aus Surinam," on pages 38 and 39, as "Grauwack."

The basal rocks are grey, reddish-grey or dark-grey, and vary in texture from very fine-grained mudstones to breccias and conglomerates containing pebbles of various sizes up to an inch in diameter.

Above these is a series of fine-grained mudstones, in places—as near the mouth of the Kuribrong River, in the Potaro River—with obscure to faint indications of stratification, or, as at the foot of Amatuk Fall in the Potaro River, with distinct signs of stratification, and in many places on the Cuyuni River near the boundary of the colony and Venezuela, on an island south-east of Takwari Mountain on the Essequibo River, and on the Mazaruni River near the Harimaraka Creek, so finely foliated as to form red and purplish-red shales. In some of the mudstones minute fragments of feldspar, frequently plagioclase, or in places microcline, of microperthite, and of quartz occur, whilst, occasionally, rounded and more or less angular fragments of felsite are found. Many scattered minute grains of magnetite, of titaniferous iron-ore with some leucoxene, and abundant minute grains of hematite and of limonite occur in them. These clastic constituents are cemented together in parts with a feldspathic cement, through which are developed patches of epidote and films, streaks, and nests of sericite, while in other places they are cemented by secondary quartz.

Carbonates are not unfrequently present in some quantity. In the finer-grained members of this part of the formation, which, as before mentioned, resemble shales in appearance, the microscope reveals only minute granules of secondary quartz and of feldspar, and films of sericite, with very abundant minute specks and grains of limonite and hematite. In some specimens narrow veins of secondary quartz, or occasionally of calcite, are noticeable.

The lower members of the formation are generally succeeded by fine-grained sandstones. Specimens of these from the neighbourhood of Takwari and of Amatuk consist of grains of quartz with a few fragments of epidote in a feldspathic matrix through which much sericite has been developed. Minute grains of magnetite are scattered in the matrix.

I have examined a large number of specimens of sandstone from the higher parts of the formation collected from various parts of the colony, and have found a general similarity in them. They are of medium texture, and, where not affected by intrusive dykes of diabase, are of a more or less pronounced red colour. In the immediate vicinity of dykes of diabase the rocks are bleached and indurated to the hardness of quartzite. They are made up of irregular, more or less rounded, grains of quartz of varying sizes, some few of which show strain-shadows, occasionally a few grains of feldspar and some flakes of muscovite. In the unaltered rocks these constituents are cemented together by limonite and by some argillaceous matter, and in the altered ones by a feldspathic matrix containing much sericite. In some of the specimens small rounded pieces of "felsite" are found, whilst flakes of more or less chloritised biotite, minute fragments of hornblende and of augite, and a few grains of sphene and of zircon have been detected in them.

The conglomerate beds consist of rounded, more or less flattened pebbles of white quartz in a matrix of sand-grains cemented together in part by limonite but more usually by a feldspathic or a siliceous material.

The sandstones from near the mountains of Roraima and Yakontipu and near the course of the Ireng River towards the western boundary between the colony and Brazil are feldspathic. They are fine to medium in texture, and are made up of small angular and sub-angular grains of quartz and of feldspar, with some larger, more or less rounded ones. The feldspar consists generally of oligoclase, microcline being present only in subordinate amount. Occasionally a few wisps of muscovite and of biotite, a few granules of epidote, and rarely a minute prism of zircon are found in the rocks. Minute grains of iron-ore are commonly present, and where the rocks are not altered their grains are held together by a ferruginous cement.

Some of these sandstones in the vicinity of intrusions of diabase are converted into quartzites, their grains being cemented or welded together by outgrowths from them of secondary quartz.

Near the source of the Takatu River micaceous sandstones resembling itacolumite are found. They consist of more or less rounded grains of quartz, of plagioclase, and some of microcline, with numerous long and narrow laths of biotite and of muscovite. Here the felds-pathic sandstones have been practically converted into mica-schist.

As a general rule this formation may be described as non-metalliferous, the large number of assays which I made of the very extensive series of samples collected from many localities in 1895 by the Kaieteur Conglomerate Expedition showing an average contents of gold of two and a half grains per ton of the rock, the highest yield being at the rate of eight and a half grains, the lowest being nil. As the materials of the sandstones and conglomerates are chiefly quartz and other minerals derived from granites, gneiss, porphyries and porphyrites—rocks which in the colony usually contain only traces of gold—the low contents in this metal of the sandstones and conglomerates are readily accounted for. The quartz-pebbles which lie on the surface of the Kaieteur Savannah are often more or less corroded on their upper exposed surfaces, parts of them having been dissolved by exposure through long ages to the solvent action of rain-water, the portions of quartz between the well-developed crystals having yielded more readily than the crystals themselves, thus leaving the surface roughened with a network of more or less well-defined small crystals.

In places on the plateau-like summit of Mount Roraima, especially in some of its shallow depressions, the surfaces of the sandstone are covered by coatings of crystalline quartz. The quartz forms hexagonal prisms terminated at one end by pyramids, some of the prisms being from one to two inches in length. It is either an example of a very coarse crystalline quartzite, in which the crystals of secondary quartz are of exceptionally great size, or it is part of a geode of secondary quartz which was formerly surrounded by the sandstone and has since been exposed by denudations. The facts, as far as known to me, favour the former explanation.

CHAPTER X.

THE PETROGRAPHY OF THE INTRUSIVE DIABASE.

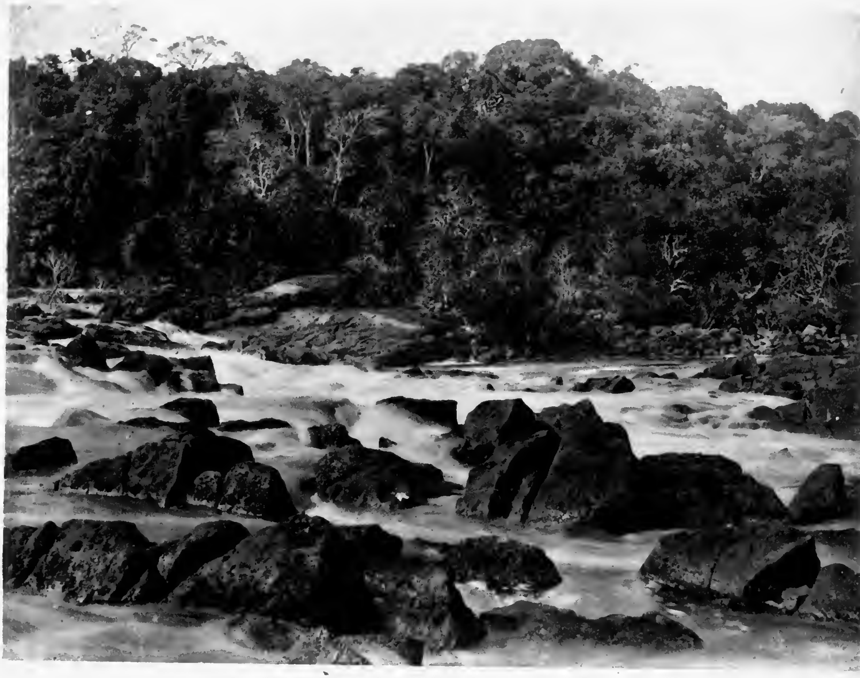
Diabase (Dolerite) occurs very plentifully in British Guiana, forming ranges of hills and mountains having a general trend from north-east to south-west, from which radiate numerous dykes, varying in breadth from tongues of a few inches to broad dykes a hundred yards or more across. In the sandstone districts it also occurs in the form of sills, not unfrequently of great thickness, which may be traced across country for many miles. C. B. Brown recognised three of these as the main ones traversing the sandstone, and marked their outcrops, over very extended areas, in his geological map of the colony.

Where the diabase occurs as mountain-masses it is of coarse texture, and approaches to the granitic structure of gabbro. But as far as I have examined the rock it always has, to a greater or lesser extent, the ophitic structure characteristic of a true diabase or dolerite, and it is, in my opinion, advisable to use the term diabase for it in all its varieties. In parts of the larger sills and broader dykes the rock also exhibits a coarse texture, but not often to so marked an extent as in the mountain masses. The outer parts of the dykes and sills usually have a much closer texture than have the inner; and in places show very compact chilled edges. In a few places the masses of diabase are traversed by later dykes of the same rock, some of which possess a columnar structure. In these secondary dykes the rock shows a structure somewhat different from its usual one, the feldspar-laths lying in a ground-mass of augite granules with scattered minute grains of titaniferous iron-ore and magnetite, and with some interstitial undifferentiated glassy matter, instead of in large irregular ophitic masses of augite. In some of these rocks porphyritic crystals of augite or of labradorite have developed, and they might be termed augite-porphyrite. The majority of the narrow columnar dykes or tongues are best described as basalts of the tholeite type.

In colour the diabase varies from dark-green to greenish-grey, grey, and dark-grey; it is most usually of a very dark stone-grey colour. It is heavy, and, as a rule, dense in structure. Its clean-fractured surface is dull and almost without lustre. The rock is hard, very tough, and resistant to the hammer; and blocks of it, when struck, resound with a clear ringing tone. The weathered surface of the masses of the rock exposed in cataracts or rapids in the courses of the rivers are covered with a thin coating or skin of varying shades of brown resulting from the oxidation of the iron-bearing minerals; and where its surfaces are not exposed to the scour of rapidly running

[To face page 86.

PLATE 8.



TUMATUMARI CATARACT, POTARO RIVER.

PORTION SHOWING EXPOSED DIABASE ROCKS.

Photo by C. W. Anderson.

waters they are frequently covered with very rough layers, from one-half to two or three inches in depth, of concretionary ironstone. The coarse-textured varieties weather with a very rough surface, occasioned by the masses of ophitic augite with their contained crystals of feldspar being far more resistant to the action of rainwater than are the intervening patches of lime-soda feldspar, which weather away, leaving the former standing out from the surface of the rock.

Not unfrequently by the sides of the rivers and streams, in ravines, and in places in the heart of the forest, masses of this rock are seen showing deep rounded flutings on their sides. These are very characteristic of the diabase, but it is difficult to explain their origin, the most feasible explanation as yet adduced being that they have been produced by the drip through ages of rainwater from the branches of overhanging trees. At some cataracts, as, for instance, at Turesi on the Mazaruni River, where broad areas of diabase are exposed at certain periods to the full glare of the tropical sun, both the horizontal and the vertical surfaces of great masses of diabases are pitted with large and small basin-shaped depressions. These are probably caused by the rock flaking away by the expansion produced on its surfaces where exposed to the rays of the sun, which frequently causes the dark-coloured rock to become too hot to allow the hand to touch it with impunity, and by the rapid contraction at night, when the temperature of the surface becomes very quickly reduced below that of the mass of the rock by radiation. The spheroidal structure so frequently present in great masses of relatively fine-grained diabase causes the flakings, instead of taking place evenly from the whole exposed surface of the rock, to result in the formation of the pitted depressions.

The products of the weathering of the diabase will be described in the succeeding section.

Examination of the surfaces of the coarser varieties of the diabase by the unaided eye shows crystalline, irregular areas of light-brown augite, interspersed with others of confused glassy-looking white laths of feldspar, with, in places, black specks of iron-ore. In the finer-textured kinds, the grey colour is seen to be due to the specking of small irregular masses of brownish augite with minute flecks or tiny rods of white feldspar, the latter becoming more noticeable as the texture of the rock becomes coarser. Specimens from a few localities in the colony show, in addition to the augite and feldspar, small oily-looking spots of a greenish-yellow tinge; these consist of olivine, and the rock is an olivine-diabase. Specimens of this may be found in the more basic parts of some of the dykes of normal diabase; but, as far as my experience goes, the occurrence of olivine in any quantity in the diabase of British Guiana is far from common.

As a general rule the diabase does not affect the indications of the compass; it is not magnetic, its contained iron-ore being generally ilmenite. But in places it does affect the compass readings, and it there contains a good deal of more or less titaniferous magnetite.

Examination of thin sections under the microscope shows that the mineral components of the diabase are few. The chief mass of the rock in all varieties is made up of pyroxene and of plagioclase-feldspar, iron-ore being present only in very subordinate quantity.

The accessory minerals I have found in the diabase of the colony are as follows :—

(*a*) *Original.*—Enstatite, biotite, hornblende, micro-pegmatite, quartz, microcline, magnetite, ilmenite, apatite, olivine, glass and microlites.

(*b*) *Secondary.*—Epidote, hornblende, biotite, chlorite, quartz, zoisite, sericite, leucoxene, sphene, serpentine, limonite, pyrite, zeolite and carbonates.

Pyroxene.—In thin sections two pyroxenes can be distinguished :—augite, the essential constituent of the rock, and enstatite, which is frequently present as an accessory, but seldom or never in important quantity. The augite is usually a pale, almost colourless variety, but in places it has a violet tinge. In some sections the usual augite is accompanied by another, also a colourless one, which has a much higher double refraction. It is only present in any quantity in specimens obtained from the mountain-masses or from the more central deeper-seated parts of the larger dykes. In these it tends to be more idiomorphic than does the common kind; it has a good prismatic cleavage, and in places shows well-marked diallagic striæ. In some sections the two pyroxenes are seen in micro-pegmatitic relationship with each other. It yields more easily to weathering agencies than does the common kind; and in some specimens in which the latter is quite fresh and unaltered, the former shows signs of alteration into bastite and into serpentinous products.

In thick sections the common augite of the diabase has a pale brown colour, and is of the aluminous type usually found in diabase. It always occurs in more or less allotriomorphic irregular masses enclosing lath-shaped sections of plagioclase. This shows that it was of later consolidation than the feldspar.

In the coarser-textured rocks enstatite, showing to some extent the pleochroism of hypersthene, is present as an accessory. Ordinary enstatite, distinguished from the augites by its low double refraction and straight extinction, is seen in small quantity in sections cut from the diabase of many of the dykes; and from its mode of occurrence it has been generally of earlier consolidation than has the augite.

Labradorite.—The plagioclastic feldspars present in places are of two periods of consolidation, the earlier being somewhat more basic than the later, but both may fairly be described as "labradorite," or in some cases as "bytownite." As a rule, the feldspars are present in the form of prisms giving, in the thin sections, lath-shaped areas. They are commonly twinned after the albite type. The lath-shaped sections, generally, do not show any zonal structure, but this is well-marked in the porphyritic crystals in the somewhat rare rocks of the porphyritic diabase type.

Iron-Ores.—These are present to a greater or less extent in all the thin sections studied, and hence may be regarded as essential minerals. As a rule, the ore present is titaniferous, and in the majority of cases it is either ilmenite, or very closely allied to ilmenite in composition and properties. In places, as for instance, near Malali on the Demerara River, and near the Sir Walter Raleigh Mine at Arakaka, on the Barima, the ore present is a titaniferous magnetite, and allowances have to be then made by surveyors for the influence of that mineral on the indications of their compasses. These iron-ores frequently carry gold in small quantities.

Apatite.—Minute stout prisms and microlites of apatite are of not unfrequent occurrence in the diabase, but are never present in more than very small proportions.

Biotite.—On the peripheries of some of the masses of pyroxene small areas of a rather light brown mica may be seen, and these are more especially noticeable in the vicinity of grains of iron-ore. This biotite is not of secondary origin, but is a product of the original magma as it became more acidic in composition by the crystallisation from it of the iron-ore, labradorite, and pyroxene.

Hornblende.—Brown basaltic hornblende is a mineral of very rare occurrence in the diabase; but peripheral areas of green hornblende, apparently original, are occasionally present on the pyroxene-masses. I attribute their presence to the same cause as that of the biotite—the gradual change in composition of the magma during the solidification of the rock.

Micro-pegmatite.—Areas of this aggregate are common in the diabase, but only in a few specimens is it present in more than unimportant quantity. It consists of microscopical intergrowths of quartz and feldspar, the latter being either orthoclase, microcline, or, more frequently, anorthoclase. Where these intergrowths are fairly plentiful, the rock tends to pass through increase of quartz into quartz-diabase.

Quartz.—Where present it is usually intergrown with feldspar as micro-pegmatite, but in specimens from a few localities the micro-pegmatite passes into irregular areas of original quartz.

Microcline.—In some thin sections cut from specimens taken from the more central parts of certain of the great dykes which are intersected by the Demerara River, above Malali, the areas of micro-pegmatite pass into small irregular patches of feldspar, showing very clearly twinning of the microcline type.

Olivine.—In a few specimens only has this mineral been noticed. It forms clear glassy blebs or crystalline grains of high index of refraction, which, under crossed nicols, show strong polarisation-colours. In hand-specimens the olivine, where noticeable, is of a very pale greenish-yellow or orange-yellow tinge, but in thin sections it appears colourless. It is of rare occurrence in more than very unimportant quantity, and I have found very few specimens of true olivine-diabase. In the Guiana diabase the place of olivine is usually taken by light-coloured enstatite; but small blebs of green serpentine in some of them indicate the former presence of olivine.

Microlites.—These are present in some quantities in parts of the diabase. They generally appear to consist of feldspar-needles, but in some cases they may be needles of augite, or of light-coloured amphibole, while some are probably apatite.

The secondary minerals in the diabase are usually confined to the edges of dykes, and to places where the rock shows signs of commencing weathering. None of these minerals are at all common, with the exception of hornblende, which, in some sections of the rock from the edges of dykes, takes more or less completely the place of the augite. It there occurs in the form of radiating fibres, or minute prisms resembling spherulites.

(*a.*) *Mountain Masses.*

The diabase of the mountain masses varies in specific gravity from 2·93 to 3·17 according to the relative proportions of the feldspar and the pyroxenes; the masses are coarse-textured rocks which, as a rule in hand-specimens, appear to be made up of blebs and porphyritic masses of pyroxene in a ground mass of white feldspar. Some specimens in which the pyroxene and feldspar are present in approximately equal proportions have a somewhat granitic appearance.

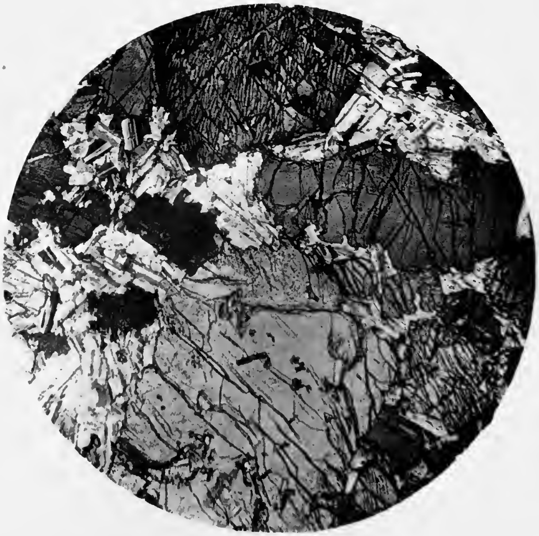
Under the microscope they are, as a rule, more or less granitic in structure, but the pyroxenes always are of later consolidation than are the feldspar, laths of the latter being in places included in the ophitic masses of pyroxene. The augite is generally present in two varieties, of which the pale brown one is almost always by far the more plentiful; diallagic markings are not uncommon in the pyroxenes, whilst enstatite in places, with faintly marked dichroism of the hypersthene type, is frequently present in some quantity. Many specimens contain more or less interstitial micro-pegmatite with, in places, small areas of original quartz. The pyroxene-masses are frequently accompanied by small quantities of peripheral green hornblende and by flakes of brown biotite, and as this is of more frequent occurrence in the rocks in which micro-pegmatite is relatively more abundant than in those in which it is rare or entirely absent, I consider that, as already stated, those minerals are probably original, and that their presence may be due to the matrix having become of a more acidic nature after the separation of the bulk of the ferro-magnesian minerals. In places, however, the biotite is clearly due to a resorption of some of the magnetite—a mineral of first separation. A separation from the pyroxenes of hornblende in fibrous aggregates is also noticeable in a few specimens, and the mineral is then clearly of secondary origin.

X.—i.

FINE-GRAINED DIABASE, × 40,
TINAMU, CUYUNI RIVER.

Photo by J. Williams.

ii.



COARSE-GRAINED DIABASE, × 30,
TAKWARI MOUNTAIN, ESSEQUIBO RIVER.

Photo by J. Williams.

Irregular grains of magnetite with sparse ones of titaniferous iron, the former in places of considerable size, are present in all the sections examined, but never in any marked quantity.

(*b.*) *Dykes and Sills.*

As a rule the dykes and sills consist of medium, fine-grained, grey to dark-grey, compact diabase varying in specific gravity from 2·90 to 3·18. In hand-specimens the only mineral usually recognisable is feldspar, which occurs in small white specks; but specimens from the inner parts of some of the dykes show structures approaching those described as characterising the diabase of the mountain-masses, and in them broad ophitic crystals and masses of pyroxene are clearly seen.

The relative distribution of pyroxenes and the feldspars in the inner and the outer parts of the dykes varies to a marked extent. In the majority of them in the outer parts the pyroxenes and the iron-ores are the preponderant minerals, whilst in the inner parts plagioclase, with small irregular areas of a micro-pegmatite of feldspar and quartz, forms by far the more abundant constituent. In other dykes the reverse is the case, the ferro-magnesian constituents being concentrated towards the middle of the mass; whilst in many there is little difference between the inner and the outer parts in this respect.

Where the inner parts are the more feldspathic they are of medium to somewhat coarse texture, and are lighter in colour and of lower specific gravity than are the outer parts. In thin sections of these the inner parts are seen to be made up of many narrow with some broad lath-like crystals of labradorite, the larger ones being in places somewhat cloudy or containing minute prisms of zoisite; small but varying proportions of a micro-pegmatite of feldspar and quartz, and a few small patches of quartz. In a few specimens the micro-pegmatite has corroded some of the laths of feldspar. In the diabase from the more central portions of the Little Malali Dyke the feldspar of the micro-pegmatite in places very clearly shows the characteristic cross-hatching of microcline.

Very pale brown to almost colourless augite is present in ophitic or in places somewhat granular masses, some parts of which show a diallagic structure, with a little more or less idiomorphic enstatite. Here and there the pyroxene-masses are bordered with a little green hornblende, small plates of brownish hornblende are of rare occurrence, while in most specimens a very few minute flakes of brown biotite are noticeable. Chlorite is very seldom found in these rocks. Magnetite and titaniferous iron-ore are always present, very irregularly distributed, in varying but usually unimportant quantities. They form irregular grains which in places are bordered with leucoxene. Minute prisms of apatite are sparsely scattered through the rocks, whilst a very few extremely minute crystals of zircon are present in a few specimens.

Where the inner are the more basic parts of the dykes the rock differs but little in structure from the foregoing, except that the ferro-magnesian minerals, and especially the iron-ores, are present in more abundance, whilst micro-pegmatite, and especially patches of quartz, are of very rare occurrence. In such specimens enstatite is usually present in greater quantity than it is in the more feldspathic parts; and in some, small granules of olivine or of its alteration-products are sparsely distributed in the pyroxene masses. A few granules of sphene are present in some specimens.

The diabase of medium to fine-texture is made up of the same minerals and aggregates of minerals as are the coarser-textured varieties. Its range of specific gravity—from 2·93 to 3·01—is not so wide as is that of the latter. It is composed of labradorite in short and narrow, lath-like crystals, with some, apparently of earlier consolidation, in short and broad plates, in places showing pericline twinning; interstitial micro-pegmatite in varying but always small quantity; and many small ophitic aggregates of pale to almost colourless augite, with, in places, a very little peripheral green hornblende, or with a few small plates of brown biotite. Granules of magnetite and of titaniferous iron ore are irregularly distributed in small grains through the rock, while apatite, in minute prisms, forms a rare accessory.

Olivine-diabase.—Typical olivine-diabase is of rare occurrence in the parts of British Guiana which I have visited. The best examples occur at the Stop Off Rapids in the Cuyuni River, at the Hiari Rapids in the Aranamai Creek of the Pomeroon River, and in a dyke in Groete Creek. It differs in appearance from the ordinary diabase of the district by showing in hand-specimens small yellowish-green to brownish-green blebs with a greasy lustre, scattered through the mass of the rock. The rock has a specific gravity of 3·00. Its structure is similar to that of the diabase, with the exception that enstatite is not present in the masses of pyroxene, that micro-pegmatite is seldom present, and then only in minute quantity, and that the masses of augite enclose many granules varying in size of almost colourless olivine, which are traversed by frequent cracks, and are in places in part, or entirely, changed to green serpentine.

Quartz-diabase and Augite-granophyre.—In places by a gradual decrease in the proportion of the ferro-magnesian minerals and an increase in the amount of feldspar and quartz and in that of micro-pegmatite, the rock passes into quartz-diabase, or into an augite-granophyre. Of the former the inner parts of a broad dyke of diabase in the lower part of the Kuriebrong River are excellent examples. The outer parts of this dyke are of normal structure, and have a specific gravity of 2·93, whilst the inner portions have a specific gravity of 2·77. The latter are of a coarse, almost granitic, texture, are light-grey in colour, and show large crystals of labradorite, with here and there small patches of pyroxene. In thin sections the rock is seen to be made up of large plates and of lath-like crystals of an andesine-labradorite, with an abundance of micro-pegmatite passing in places into patches of quartz—some of which are granular—and a relatively few ophitic aggregates of very pale, almost colourless, augite, with a little enstatite, and with some peripheral green hornblende and a little chlorite; some large irregular grains of titaniferous iron-ore and a few minute prisms of apatite. Patches of zeolite and some plates of carbonates are present as alteration-products.

In the augite-granophyres, the best example of which was found in the upper part of the Konawaruk River, a micro-pegmatitic ground-mass of feldspar and quartz contains crystals of labradorite, which in places are more or less clouded, patches of quartz, irregular granules of a pale, almost colourless, augite, and some granules of titaniferous iron-ore.

Basaltic-diabase or Tholeite.—This type occurs only in narrow dykes traversing some of the larger masses of the normal rock, as at Tumatumari, and in the chilled margins of some of the smaller diabase dykes. It is a dark-coloured, fine-grained rock of specific gravity ranging from 2·95 to 2·99. The rock consists of small prisms of labradorite, their edges in places showing signs of corrosion and some small granules of augite; embedded in a ground-mass of augite, minute grains of magnetite and some ill-defined interstitial matter, largely consisting of glass.

Tachylite.—A dyke near Kuiai Lake, on the Berbice River, consists of a very fine-grained diabase, of specific gravity 2·98, and has a glassy tachylitic margin of specific gravity 3·01. This margin consists of a crypto-crystalline glassy matrix containing very abundant minute grains of magnetite, and traversed by cracks which are filled with chlorite and calcite. In places flow-structure is well marked. Few diabase dykes in British Guiana show margins of this sort; and this is the sole instance that has been found during my recent investigations; but other instances, from places south of where these examinations have extended to, have been brought to my notice.

On the edges of some of the larger dykes the diabase is a good deal altered, the feldspars being saussuritised to a greater or a less extent; and the outer parts of the augite-masses changed to pale-blue or green hornblende in places, to such an extent that the former is almost or even entirely replaced by the latter, while in others chlorite has been developed at the expense of some of the ferro-magnesian minerals.

As a rule, these contact-rocks contain more pyrite than does the mass of the diabase; and, as this is generally more or less auriferous, in many cases the former contain far higher proportion of gold than do the latter. This was the case in samples I collected in the Essequibo district, the modified diabase yielding 26 grains of gold to the ton of the rock, while the diabase gave only at the rate of 5 grains. In a few places, as at the Growler mine in the Potaro gold field, contact-rocks are in parts rich in gold, some samples having yielded upon assaying at the rate of 5 ounces of gold to the ton of the rock. These exceptional instances were excluded from the foregoing calculation.

In parts where diabase has sent very long and narrow tongues into acidic rocks, such as granite or gneiss, the basic rock, in addition to undergoing the endomorphic changes which have resulted in altering the augite to hornblende or to chlorite and epidote, has taken up some of the constituents of the acidic rock; and the diabase of the tongues is less basic than is that of the dykes or bosses from which they are apophyses. For instance, the diabase in the neighbourhood of the Great Yukuribi Falls on the Essequibo River has a mean specific gravity of 3·04, while that of a narrow vein intrusive into the gneiss of the falls has one of 2·86; and the diabase of the great mass forming Tiboku Heights in the Mazaruni River has a specific gravity of 3·06, while that of a narrow vein traversing the quartz-granophyre of the Tiboku Cataracts has one of 2·92.

It is everywhere noticeable that the contact-rocks near the edges of dykes of diabase are far more subject to decomposition than are the masses of the dykes; and it is frequently a matter of great difficulty to obtain specimens from the actual contacts, the rocks from these, as a rule, in the natural sections at the falls and rapids of the rivers, which are the only ones at our disposal, being more or less completely eroded away. This more rapid degradation of the contact-rocks is doubtless in part due to the higher proportion of pyrite which they usually contain. The gold contained in the placer-gravels in many places has been derived from the degradation of such contact-rocks; and it has been frequently noticed that the metal has been obtained in much larger quantity than has been the rule elsewhere in those parts of claims where the usually greyish-white or blue clay of the bedrock is crossed by bands of red or deep ochre-coloured material, which indicate the former presence of dykes of basic rocks.

In some places diabase is found which has been much altered—the pyroxenes having been changed into aggregates of epidote and chlorite, whilst the mass of the rock is penetrated by infiltration-products such as the carbonates of iron, magnesium and calcium, and secondary quartz. These are not infrequently accompanied by pyrites—arsenical and in places cupriferous—and by galena. These rocks are in places more or less auriferous, but never to a payable extent. The infiltration-products may have been derived from the decomposition of diabase, which at one time overlaid that from which these residuary masses were derived and which is now represented by great depths of red and ochreous clays and layers of concretionary ironstone. In parts these products are due to mineralisation or impregnation by percolating waters during or after the intrusion of the basic rocks.

As a general rule the diabase is affected by weathering to only slight depths on its surface, the rock passing in the thickness of a fraction of an inch from an ideally fresh and unaltered condition to that of an ochreous clay; but in some places, especially in many of the placer-gravels, blocks of diabase which have undergone less well-marked changes are found. The diabase in these has been changed to a greenish, earthy-looking rock, containing much chlorite, viridite, in places epidote, and some pale-blue hornblende; while the feldspars are more or less kaolinised, secondary quartz being a frequent accessory. The iron-ores, with the exception of pyrite, are but little, if at all, altered; and, as products of the alteration of the rock, the carbonates of iron, calcium and magnesium are present in abundance.

THE CHEMICAL COMPOSITIONS OF THE DIABASE.

The chemical compositions of the diabase of the colony are shown in the following analyses :—

	Arakaka District, Barima River.	Cuyuni River.	Mazaruni River.	Essequibo River.	
				Mountain Masses.	Dykes.
Specific gravity	3·02	2·99	2·96	3·07	3·00
Silica	50·76	53·16	51·68	52·00	51·37
Alumina	16·83	15·01	13·52	17·29	13·90
Iron peroxide	4·16	1·27	4·87	2·90	4·55
Iron protoxide	4·45	8·29	9·71	8·26	9·86
Magnesium oxide...	10·09	7·45	5·19	6·95	6·64
Calcium oxide	11·30	10·36	8·84	8·80	10·36
Sodium oxide	0·97	2·22	2·14	2·81	2·42
Potassium oxide	0·06	1·16	0·12	0·18	0·06
Water	0·14	0·56	0·50	0·35	0·50
Carbonic anhydride	—	—	0·04	0·06	0·10
Titanium oxide	0·46	0·16	1·20	0·53	0·32
Phosphoric anhydride	—	0·08	0·17	0·008	trace.
Chlorine	—	0·003	—	—	—
Iron sulphide	—	trace.	0·80	0·005	0·002
Cobalt oxide	trace.	0·009	0·55	—	trace.
Manganese oxide...	0·69	0·15	0·66	0·05	0·12
Barium oxide	—	0·15	—	—	—
Copper oxide	trace.	0·09	0·01	trace.	trace.
Lead oxide	—	—	0·02	—	—
	99·91	100·122	100·02	100·193	100·202

	Potaro River.		Demerara River.	*Olivine-diabase.*
	Dykes in Sandstone.	Dykes in Lower Potaro.		Cuyuni River.
Specific gravity	2·97	2·97	3·01	3·00
Silica	52·62	51·19	54·21	52·18
Alumina	16·75	15·80	13·25	15·59
Iron peroxide	2·72	3·08	4·26	0·75
Iron protoxide	7·91	11·20	10·00	8·11
Magnesium oxide	5·98	5·63	5·03	7·89
Calcium oxide	10·19	9·58	8·99	10·40
Sodium oxide	2·39	2·09	1·79	2·88
Potassium oxide	0·25	0·60	0·74	1·25
Water	0·80	0·30	—	0·73
Carbonic anhydride	0·04	—	0·04	—
Titanium oxide	0·40	0·40	1·49	0·16
Phosphoric anhydride	0·005	0·008	0·013	0·05
Chlorine	—	—	—	0·003
Iron sulphide	0·002	0·005	0·005	0·008
Cobalt oxide	—	trace.	trace.	—
Manganese oxide	trace.	trace.	0·21	0·16
Barium oxide	—	—	—	0·14
Copper oxide	trace.	trace.	trace.	0·05
Lead oxide	—	trace.	—	—
	100·057	99·883	100·028	100·351

In addition to the constituents mentioned in the foregoing analyses, careful examinations have shown that all the samples of diabase collected have contained more or less gold and silver; the former in quantities varying from unweighable traces to 17 grains per ton of the rock, the latter from 3 to 5 grains.

The following analyses illustrate the composition of the altered diabase containing green hornblende and chlorite :—

	Essequibo and Potaro Rivers.	Mazaruni River.
Silica	50·72	52·19
Alumina	16·35	15·47
Iron peroxide	4·07	8·30
Iron protoxide	8·06	3·65
Magnesium oxide	5·81	4·59
Calcium oxide	7·08	8·26
Sodium oxide	2·38	2·71
Potassium oxide...	0·66	1·48
Water	2·87	0·90
Carbonic anhydride	1·50	0·15
Titanium oxide	0·12	1·24
Phosphoric anhydride	0·001	0·10
Chlorine	trace.	0·13
Iron sulphide	0·005	0·26
Cobalt oxide	—	—
Manganese oxide	trace.	0·13
Barium oxide	—	0·08
Copper oxide	—	trace.
Lead oxide	trace.	—
	99·626	99·66

THE MINERALOGICAL COMPOSITIONS AND CLASSIFICATION OF THE DIABASE.

From the chemical and microscopical examinations outlined in previous pages the probable mineralogical compositions of the diabase rocks, and their classification in accordance with their ultimate magmatic constitution, have been calculated. The mineralogical compositions, calculated from the results of the analyses, differ from those shown by the microscopical examinations by the relatively high proportions of uncombined silica indicated in them, and which should, presumably, be present as quartz in the rocks. Although quartz is shown by the microscope to be of rather common occurrence in these diabases, its proportion in no case approaches that indicated by the calculations. The feldspar present in them is shown by the analyses to be a basic labradorite or bytownite. This is in accord with the optical determinations. The augite present appears to contain relatively large proportions of the enstatite-molecule with the augite one. The presence of enstatite is not uncommon in the rocks; but the mineral itself is never there in the proportions indicated by the analyses. Hence its constituents must be in the augite.

The following are the mineralogical compositions calculated from the analyses given on page 95:—

	Arakaka District, Barima River.	Cuyuni River.	Mazaruni River.	Essequibo River.	
				Mountain Masses.	Dykes.
Quartz	7·7	1·5	9·0	2·4	3·7
Orthoclase	0·3	6·7	0·6	1·1	0·5
Bytownite (Ab_1, An_3)	—	46·1	44·8	57·8	47·1
Bytownite (Ab_1, An_6)	49·8	—	—	—	—
Pyroxene	34·1	42·7	35·4	33·3	41·2
Magnetite...	6·0	1·9	7·2	4·2	6·5
Ilmenite	0·9	0·3	2·3	0·9	0·6
Apatite	—	0·1	0·3	0·2	—
Water	—	0·5	—	—	—
Minor constituents	1·2	0·2	0·4	0·1	0·4
	100·0	100·0	100·0	100·0	100·0

	Potaro River.		Demerara River.	*Olivine-diabase.*
	Dykes in Sandstone.	Dykes in LowerPotaro.		Cuyuni River.
Quartz	5·2	3·2	11·2	—
Orthoclase	1·4	3·3	4·4	7·2
Bytownite (Ab_1, An_3)	54·0	49·8	40·8	—
Labradorite (Ab_1, An_2)	—	—	—	50·5
Pyroxene	33·8	38·0	33·3	30·2
Olivine	—	—	—	9·9
Magnetite	3·9	4·4	6·3	0·9
Ilmenite	0·8	0·8	2·9	0·3
Apatite	0·1	0·3	0·3	0·2
Water	—	—	—	0·7
Minor constituents	0·8	0·2	0·8	0·1
	100·0	100·0	100·0	100·0

The diabase from the Barima, Cuyuni and Demerara districts is Auvergnose, that from the Essequibo and Potaro districts Hessose, and that from the Mazaruni district Vadose. The olivine-diabase is an Auvergnose.

The mineralogical compositions of the somewhat altered diabase containing hornblende and chlorite are as follows :—

	Essequibo-Potaro District.	Mazaruni River District.
Quartz	9·5	7·6
Orthoclase	3·9	8·9
Labradorite (Ab_1, An_2)	37·1	48·3
Pyroxene, hornblende and chlorite	42·5	30·3
Ilmenite	0·1	2·3
Apatite	—	0·3
Calcite	3·4	0·3
Water	2·8	0·9
Minor constituents	0·7	1·1
	100·0	100·0

The rock from the Essequibo-Potaro district is an Auvergnose and that from the Mazaruni an Andose.

CHAPTER XI.

RECENT FORMATIONS.

The Fluvio-marine Deposits.—Little can be added to the descriptions of these already given. The argillaceous members of the series consist of pipeclays, more or less ferruginous brick-earths, and sandy loams. As a rule, they contain very few distinguishable minerals other than kaolinite and quartz, although, by careful elutriation, microscopical crystals of zircon and grains of ilmenite occasionally have been detected.

The sands consist, as a rule, almost entirely of quartz-sand, in places white, but usually of varying shades of yellow and light-brown, according to the proportion of ferruginous matter which is adherent to the grains of quartz. A few grains of sphene, of ilmenite and of zircon, have in places been detected in them, while some beds contain flakes of mica in more or less abundance, biotite being far more prevalent than muscovite. The alluvial deposits are essentially marine-borne silts, derived probably from the erosion of fluviatile alluvium; and their relative freedom from heavy minerals is in accordance with this.

The shell-beds which in places occur in them contain many kinds of shells, all of which are found at the present time living in the surrounding shallow sea.

The Residuary Deposits.—The composition of these varies according to the variety of rock they have been derived from. Aplite, granite, pegmatite, quartz-porphyries, the more acidic granitites, and the gneisses and schists derived from them, give rise to more or less sandy kaolins and pipeclays, varying in colour from white to cream-coloured. The hornblendic granites and gneisses and the allied porphyrites and schists produce ochrey-coloured more or less ferruginous clays, whilst the diabase, diorite, epidorite, amphibolite, and hornblende-schist weather into buff-coloured, red, brown, or chocolate-coloured, ferruginous, more or less siliceous earths. These latter consist of mixtures in various proportions of angular quartz-sand and siliceous grit, derived either directly from the quartz originally present in the rock, or secondarily, from the decomposition of the feldspars; of kaolinite, arising from the feldspars; and of limonite, or other hydrated oxides of iron, resulting from the decomposition, hydration and oxidation of the various ferro-magnesian minerals present in the rock.

A distinguishing feature of the residuary deposits from the fluvio-marine ones is the relatively great abundance of heavy minerals contained in the former. In the residuary deposits from the acidic rocks the unaltered minerals (besides quartz) present in them are usually in very small proportions, and consist of sphene, magnetite and ilmenite, apatite and zircon, while in those derived from granite, or muscovite-granite, muscovite is present in some abundance, together with small crystalline grains of corundum. Tourmaline (schorl), topaz, beryl, garnet and spinel are also found in certain residuary deposits derived from metamorphosed granites. The residuary deposits from the basic rocks always contain ilmenite in more or less abundance, magnetite in lesser quantity, some apatite, and, in places where rocks were much metamorphosed prior to detrition, grains of the epidote in small amount. The residuary deposits derived from the unmetamorphosed acidic rocks are at present, at any rate, of very minor economic importance to those derived from the basic ones. They are not, as far as is known, the source of any metal or mineral of economic importance. Small quantities of kaolin have been exported to the United States, and there used in various ways. The following shows the chemical compositions of samples of kaolin from different localities in the colony:—

	Courantyne.	Penal Settlement, Mazaruni River.	
Combined water	12·64	10·32	6·73
Quartz	6·59	25·66	51·74
Silica (combined)	45·52	35·36	23·20
Alumina	32·53	25·26	14·38
Titanium oxide	0·01	1·10	0·60
Iron peroxide	1·36	1·22	2·89
Calcium oxide	0·02	—	—
Magnesium oxide	0·61	0·11	0·11
Potassium oxide	0·17	0·48	0·53
Sodium oxide	0·52	0·25	0·53
Phosphoric anhydride	—	0·01	0·01
	99·97	99·77	100·72

In a few places the acidic rocks are found in a mineralised condition, and the residuary deposits from them contain, in addition to some of the minerals already mentioned, gold in dust and small nuggets. Some of the gold found in the Omai Bonanza was doubtless derived from rocks of this sort, which are there highly developed. The mineralised masses in parts have been altered into hydrous micas of the sericite type; and these now form portions of the residuary deposits, being resistant to weathering agencies and hence not kaolinised.

The laterite deposits from the basic rocks are of great economic importance. They are the matrix of much of the so-called alluvial gold of the colony, and, as a rule, they represent the country through which layers and veins of auriferous quartz extend. They consist of red or ochreous, sandy to gravelly clays, with layers of angular quartz fragments, and with, in many places, layers, boulders and nodules of concretionary ironstone. The titaniferous iron-ore, present to a considerable extent in the diabase and allied basic rocks, undergoes but little alteration by weathering, and is found in the earths in the form of black sand. One of the surest signs on the rivers of approach to an area of basic rocks is the occurrence *in quantity* of black sand among the river sands and gravels.

The clay produced from the basic rocks varies in depth of colour according to the quantity and composition of the ferro-magnesian minerals present in the rocks; those rich in iron compounds giving rise to deep-red and chocolate-coloured clays, while those with less amounts result in red, light red, or ochreous clays and earths. The surfaces of these clays are not unfrequently more or less bleached by the action of the organic acids present in the percolating waters of the soils of the forests, and frequently, where the surface-soil of the forest has a light colour and gives no indications of underlying basic rocks, the earth thrown up from the tunnels of armadilloes and other burrowing animals is of a red or deep-ochreous colour, showing the presence of the characteristic degradation-products of the basic rocks.

In many places the bulk of the laterite consists of very finely divided particles, and is there very absorbent of water. Earths of this character, when saturated or nearly saturated with water, in place of becoming plastic and tenacious, as true clays do, approximate in character to viscous liquids, transmit hydrostatic pressures, and, as on the slopes of hills, flow more or less freely under the influence of gravitation. To this may be ascribed the formation of the numerous small faults which characterise the layers of quartz found in the laterites of the Arakaka district; whilst, as will be shown later, these properties explain to some extent the concentration of gold, of quartz and ironstone in the lower layers of certain of the laterites.

The following analyses indicate the chemical composition of the laterite deposits:—

	Tumatumari.	Penal Settlement.
Combined water	11·18	9·03
Silica	51·76	60·10
Alumina	24·55	20·55
Titanium oxide	0·67	0·90
Iron peroxide	11·34	8·54
Manganese oxide	trace	—
Calcium oxide	0·23	0·01
Magnesium oxide	0·21	0·11
Potassium oxide...	0·21	0·48
Sodium oxide	0·14	0·53
Carbon anhydride	—	—
Sulphur anhydride	0·03	—
Phosphoric anhydride	—	0·02
	100·32	100·27

Much of the iron set free during the decomposition of the basic rocks which is already in the state of, or is reduced to ferrous iron, is brought into solution by the carbonic acid and the organic acids of percolating waters, and is thus enabled to move through the mass of the laterite. Parts of it exist in solution as ferrous bicarbonate, and these, when brought into conditions where that compound becomes dissociated, are thrown out of solution and oxidised, giving rise to coatings and layers of limonite. The portion held in solution by the organic acids of the tropical soil waters may be leached out of the laterite but it will be deposited as limonite when the solution undergoes oxidation, with attendant destruction of the organic acids. The limonite forms either pisolitic grains of concretionary ironstone, or more frequently surrounds particles of siliceous sands, binding them together where relatively abundant into ferruginous sandstone, or where the sands are less abundant using them as nuclei for the formation of masses of impure concretionary ironstone. In places these masses of concretionary ironstone form great boulders, some of which largely exceed a ton in weight.

By the gradual washing away of the finer particles of the laterite, in cases where the concretionary ironstone has been distributed through the deposit, the surface becomes covered with layers of ironstone standing out from the surface of the mass. Where the laterite has been washed from the sides of the hills and rearranged by the action of running-water, either in the ravines or in the stream-valleys, the ironstone, together with more or less quartz-gravel, gives rise to beds of coarse ironstone gravels and conglomerates.

The surface-layers and the great boulders generally are in the form of ruddy, cindery-looking masses with very numerous small cavities, the structure of which caused the Creoles of the neighbouring French colony to name the rock "Roche a Ravet" (cockroach-rock), the small holes serving well for the hiding-place of specimens of *Blatta Orientalis.*

The chemical composition of the concretionary ironstone is shown by the following:—

	Kobanatuk Fall, Potaro River.	Oewang Creek, Potaro River.
Combined water	17·30	13·70
Carbon anhydride	—	0·14
Silica	7·68	9·86
Titanium oxide	1·31	0·89
Alumina	7·24	9·15
Iron peroxide	66·42	66·41
Calcium oxide	0·11	0·11
Magnesium oxide	0·12	0·32
Phosphoric anhydride	trace	trace
	1C0·1	100·58

In some specimens of the ironstone the limonite has been changed more or less completely into hematite.

The concretionary ironstone is usually auriferous, and samples which I have examined have varied in their contents from mere traces of the metal to as much as sixteen pennyweights per ton of the rock ($14·28 value per ton of 2,000 lbs.).

Readers who are desirous of a fuller account and discussion of the Guianan laterites and concretionary ironstone are referred to the monograph by G. C. de Bois, entitled "Beitrag zur Kenntnis der Surinamischon Laterit un Schutzrindenbildungen," in "Tschmaks Mineralogische und petrographische Mitteilungen, XXII. Band, 1. Heft. 1903."

Among the heavier minerals which tend to sink into the lower layers of the laterite, one—ilmenite—is very conspicuous in the stream and river gravels and sands in the laterite districts. This gives rise to black sands, which usually consist almost wholly of ilmenite, although in places it is mixed with more or less magnetite. The sands, as a rule, contain higher proportions of ilmenite and lower ones of magnetite than do the titaniferous iron-ores of the rocks from which the sands have been derived, the magnetite offering less resistance to deoxidising agencies than does the ilmenite. As would be expected the ilmenite sands are generally accompanied by gold, partly in the free state, and partly included in the mineral. Samples collected by myself have been examined for their contents of precious metals, with the following results, given in grains per ton (2,240 lbs.).

	Gold.	*Silver.*
Sand from Ichaura Rapids, Potaro River	27	4
Sand from Kobanatuk Rapids, Potaro River	29	4
Sand from Orimetuk Creek, near the Kaicteur, Potaro River	19	—
Sand from near Wariri, Cuyuni River	118	150

Ilmenite sand from a placer claim in the Konawaruk district was found to be accompanied by seven pennyweights of gold to the ton of the sand; whilst sand of which the following is an analysis, obtained from the valley of the Minnehaha Creek, Konawaruk River, yielded at the rate of twenty-one pennyweights of gold per ton:—

Silica	2·54
Titanium oxide	52·03
Iron peroxide...	5·96
Iron protoxide	37·14
Manganese oxide	trace
Alumina	1·87
Magnesium oxide	0·60
	100·14

The samples collected from near Wariri, when examined with the aid of a magnifying glass, did not show any signs of free gold.

Dr. Emil E. Lungwitz, in a paper published in 1900 in *The Mining Journal, Railway and Commercial Gazette*, entitled "The Placers of British Guiana," directed attention to the movements of the residuary deposits when saturated with water, and showed that from these effects, the movements can be regarded as "pseudo-glacial." He stated that the downward movements of the deposits on hill-sides resulted in breaking up the quartz-reefs, whether original fissure-reefs or veins of secondary quartz which occurred in them. And he described the formation of the coarse angular quartz-gravel so characteristic of many of the placer-workings as follows:—

"That we must discard the mechanical force of running water if we wish to explain the origin of the Guiana placers may be inferred from the fact that in many of the placers the gold-bearing gravel consists entirely of sharp-edged quartz pieces, extends evenly from hillside to hillside, clear across the valley, and is usually for the total distance evenly productive. This angular quartz has not been carried from the hillside to the valley by any running water, but, as I shall show, exclusively by the pseudo-glacial movement of the cumulative clays. The topmost layers of these clays is ever kept saturated with water, which, while draining off, lessens the friction between the molecules of the clay, and in this way becomes responsible for its plasticity. To illustrate and to prove this contention I wish to cite the following observations:—The Omai placers, situated on the left bank of the Essequibo River, have yielded from a territory not exceeding 300 by 4,000 feet 65,000 ounces of gold. The gravel of this placer consists of ironstone and quartz pebbles, with a liberal amount of angular quartz, which occasionally exhibits large amounts of free gold. The first owner of this placer spent some money to find the reefs to which he attributed the placer gold. An Australian miner, whom he employed, was lucky enough to strike a reef two feet thick, and of wonderful richness. This vein dipped about 12° towards North-west. Where it entered the clay it was split, but the main point of my observation is that its outcrops, greatly broken up, were deflected in the direction the clays were moving. Two other reefs above this one, but approximately parallel with it, outcropped on the west side of the same hill, the slope of which was slightly steeper than the pitch of the vein. Both reefs were broken up into pieces of different size near the surface. Drifting upon them revealed the fact that the upper vein was crushed for a greater distance than the lower one, but just this part showed unmistakable evidence that the clays had been sliding upon its surface, while the upper one was crushed to pieces, often lying inches apart.

"This pseudo-glacial movement may even produce an inversion of reefs. At Anderson Creek, a tributary of the Potaro River, I was charged to examine a reef, whose outcrop could plainly be followed for some hundred feet. The outcrop appeared upon the left bank of the creek, in the bed of which angular quartz pieces predominated. The slope of the hill was slight. Throwing out ditches revealed the presence of a layer consisting entirely of angular quartz pieces, which, the nearer we approached the hilltop, were buried deeper and deeper in the clay. This layer, however, came to a sudden stop, and then we just as suddenly struck the reef about six feet below the surface. Ditching higher up the hill failed to reveal a single piece of quartz.

In this case the sliding clay had carried pieces of the roof towards the valley.

"Of all common minerals only quartz can withstand this cumulative decomposition; quartz reefs, therefore, come up to the surface in the measure as their thickness and their cohesion increase. The four-foot reef of the Kanaimapoo mine on the Demerara can be traced on the surface for quite a distance, and the Blue reef in the Garnett Syndicate, on Tiger Creek, can at several places be seen right in the placer workings. All others of less magnitude or cohesion are shattered, and their sharp-edged pieces are carried to the valley. These clays, during the process of sliding, shrink as the water drains from them, and it is for this reason that the outcrop of the vein in Anderson Creek appeared at the surface only after it had travelled a distance of some 160 feet."

I have seen several instances of similar movements in the North-Western district, and some of them were described in the report by Perkins and myself on the gold fields of that district, published in 1897. In the following paragraph we ascribed the numerous small faults which we had noticed in the quartz reefs to the same cause:—

"The small faults, in our opinion, are of purely local origin, due in part to the alteration in volume of the underlying rocks by progressive hydration, oxidation, and decomposition, and in part to slips and slides on the hillsides."

Near the Winter mine in the Arakaka district there is a section in which, on the slope of a hill, a quartz vein has been inverted and more or less shattered, so that the portion of it higher on the hillside overlaid that lower down, apparently having been pushed forward, and inverted in the process. This was probably due to the slipping of the residual deposits of which the hill consisted, in the manner described in the above quotation from Dr. Lungwitz's article.

CHAPTER XII.

DESCRIPTIVE GEOLOGY.

THE NORTH-WESTERN DISTRICT.

The Amacura River.—The Amacura River forms the western boundary of the colony, and the structure of the district it traverses has been described by Mr. H. I. Perkins, F.G.S., who travelled on it during the delimitation of the Venezuelan Boundary in the year 1900–1901. The following is the description given in his report published in 1901 :—

"No rocks are met with in the lower portions of the Barima and Amacura Rivers. In the Amacura the first rocks are found a few miles below the Falls of San Victor, which, like those of the falls, are composed of a coarse granite, with small veins and stringers of quartz running through them. Above the falls, again, for many miles the rocks are granite, and in places large boulders occur in the river bed. The banks are composed chiefly of the decomposition-products of granite and gneiss, and gneiss is found at Juanita and Middle Camp. Between these two places extensive dykes of hornblende-rocks occur, giving where they have weathered the characteristic red and ochreous clays stained by the oxidation of their ferro-magnesian constituents. The Upper Amacura runs almost entirely through a gently undulating granite and gneiss country, whilst its affluent, the Polvo de Oro, on a tributary of which a man named Jeffrey is digging gold, traverses more hilly ground composed of diabase and hornblende-schist—dykes in the granite and gneiss. At its head the Polvo de Oro flows over a mass of hornblende-schist dipping at a high angle with the horizon. Two miles below Middle Camp a very fine exposure of quartz, eight feet wide, is seen in hornblende-schist on the British side of the stream. I did not procure any specimen of it, but have brought down pieces of gneiss, granite, and hornblende-schist from Juanita, Middle Camp, and Polvo de Oro heads.

"As a gold district I do not consider there is a promising outlook on the English side of the river, and though gold undoubtedly exists in the Polvo de Oro and its branches, it does not seem to me to exist in sufficient quantities to attract a large number of diggers."

The specimens from the Amacura, collected by Mr. Perkins, show that, as he states, the country is gneiss and gneissose granite, the rocks having the following characters :—

Granitite-gneiss.—This is made up of a granitic aggregate of feldspar, in part orthoclase and in part oligoclase, and of irregular patches of quartz showing strain-effects; with small flakes of greenish biotite and a few granules of epidote scattered through the mass.

Hornblende-granitite-gneiss.—A granitic aggregate of feldspar, some of which is oligoclase, and of quartz showing strain-effects, with small irregular plates of pale-blue hornblende, some flakes of brown biotite and a few of muscovite; a few granules of epidote, and some grains of sphene and of melanite form unimportant accessories. The larger plates of feldspar consist of orthoclase, and are more or less sericitised.

Gneissose-granite.—This rock consists of large microperthitic plates of alkali-feldspar, which in places are clear and show the structure of microcline, whilst in others they are crowded with sericite or traversed by thin veins of secondary muscovite; plates of oligoclase, and irregular patches of granulitic quartz with small flakes of more or less chloritised biotite.

The specimens of basic rocks are hornblende-schist of the following types :—

1. A dark-coloured, rather fine-grained rock consisting of small plates of pale-blue hornblende, lying with their longer diameters parallel to one another in a micro-mosaic of grains of water-clear feldspar, with some of well-defined plagioclase, through which are scattered a few minute grains of epidote and of sphene of the leucoxene-type.
2. A hornblende-schist of more compact structure than the foregoing, made up of very abundant angular grains of pale-blue hornblende in a micro-mosaic of grains of water-clear feldspar.

The Aruka River.—Large areas in the northern parts of the North-Western district are very low-lying, and are occupied by swamps. A range of low hills, probably nowhere more than 150 feet high, runs on the northern side of the Aruka River, approximately parallel to it, from about $3\frac{1}{2}$ miles S.W. of Morawhanna for a distance of about 17 miles. A few low rounded hills occur near its southern bank. The hills consist either of hornblende-schist, as at Maburima and near Youpu Creek, or of a massive epidiorite as at Issorora. The plain from which this range rises is a part of the gneissose complex of the Guianas, and specimens of its rocks have been obtained from near the Lower Maburima Creek, from a small island in the Aruka, and, as already described, from the Amacura River.

The epidiorite and the hornblende-schist contain gold in small quantities, varying from traces to 34 grains per ton of the rock, the mean contents of the samples examined being 9·6 grains. Unfortunately the topography of this district is not favourable for the formation of placer-deposits, which, if they occurred in the vicinity of these hills, should be rich; but colours of gold have been found in the gravels of the Maburima and the Araua Creeks.

The Barima River.—Low hills of more or less decomposed hornblende-schist occur on both banks of the Barima River, at Mount Everards, Mount Terminus and near the Goodewi Creek, about 46 miles from Morawhanna. The gravels derived from them are probably more or less auriferous.

At Koriabo, 20 miles from Mount Everard, is a low hill of red ferruginous earth, the residue of a diabase, resting on cream-coloured sandy clays derived from gneiss. I detected in the red earth minute colours of gold.

The Barima River in its course from Koriabo to near McIntyre's Landing has cut its channel through the basal gneiss of the colony. This is intersected at Bamboos, and at between two or three miles west of that place by dykes of diabase, the positions of which are shown by the occurrence of red clays and concretionary ironstones on the banks of the river. Near to an old Indian settlement to the east of Queaque Creek, at a place known to the gold-diggers as "Flat Rock," the gneiss is intersected by a broad outcrop of a grey-coloured gneissose granite, a considerable area being exposed when the water in the river is low. To the westward of this place some narrow dykes of diabase traverse the gneissose rocks. From near McIntyre's Landing to the foot of Mekorerusa or Eclipse Cataracts, the exposures along the course of the river indicate that the country is generally a schistose one, there being exposures of quartz-schist, chlorite-schist, and of more or less decomposed mica-schist. In places the schists are cut through by dykes of diabase, which cross the course of the river between the great masses of that rock which form the hills on its banks. These dykes are more frequent and of larger size in the district between the lower mouth of the Manicuru Creek and that of the Arakakaparu Creek than elsewhere in this part of the colony.

Only the larger of the dykes are recognisable, except when the water in the river is very low, and even then the smaller ones are more usually indicated by the presence of bars of more or less tenacious red laterite than by that of the unaltered greenish-grey to blackish-grey rock.

The Mekorerusa, or Eclipse Cataracts, are over a granitite of a decidedly gneissose character. The rock is grey in colour, and somewhat coarse in texture. At Yakiri Creek it is crossed by an intrusive dyke of a fine-grained biotite-diorite, the outer parts of which, where in contact with, or close to, the granitite, show well-marked schistosity, due to fluxion in the pasty mass during its intrusion.

At Uropocari Rapids the gneissose granitite, which is similar to that at Eclipse Cataracts, is traversed by many narrow veins of intrusive basic rock. Near to these the granitite is altered, and shows a foliated structure.

Near Duquari Creek, for a distance of about one and a half miles, the granitite is traversed by a dyke of epidiorite, which, in parts, has a massive structure, and in others a schistose one.

Above Duquari Creek the Arawatta rocks form a marked feature in the scenery of the river. They consist of a grey-coloured, fine-grained, gneissose granitite, which rock is also exposed at intervals for about two

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PLATE 9.

ARAWATTA ROCKS (GRANITE), BARIMA RIVER, NORTH-WEST DISTRICT.

Photo by H. I. Perkins.

and three miles further up the river. A red gneissose granite occurs below Wanaparu Creek, and in it intrusive veins of pinkish aplite occur. A similar aplite is seen in a grey gneiss opposite to Wanaparu Creek, and again in red gneissose granite which the river traverses for about four miles above the mouth of the Mehokowaina Creek, while an aplite is intrusive in grey gneiss near Five Star Landing. The gneiss near Wanaparu Creek is a hornblende-granitite-gneiss. About three miles above the junction of the Mehokowaina Creek the red gneissose granite is traversed by a white-spotted, dark-grey epidiorite, which, in places, shows a somewhat schistose structure. Similar more or less schistose rocks traverse the grey gneiss and the gneissose granites in many places between here and Five Star Landing. Some eight miles below Carriage Falls, at a small rapid, a dyke of diorite, about five feet in thickness, occurs in grey gneiss. The character of the country is well shown by the fine-grained grey gneiss exposed at Carriage Fall and at Hellgate Fall.

In the neighbourhood of Five Star Creek and of Jimbo Landing the rocks forming the hills consist of diorite and of epidiorite passing to hornblende-schist. This structure of parts of the colony, as here and in the Puruni River district, by degradation gives rise to payable auriferous deposits. Some small diamonds have been found in the placers of this district.

The geology of the source of the Barima River, and of the Barima-Barama divide, was described by Mr. Perkins as follows :—

"The country at the Barima head is densely covered with forest throughout, and is at an elevation ranging from 350 to 1,600 feet above sea-level. The Barima has its source on the Imataka Mountains, which are there some 950 feet high, composed of diabase and are highly magnetic ; I believe they contain gold and other minerals, and I have no doubt the various lines cut by the survey will be of use to prospectors in traversing the district. At the head of the Kaliaku quartz-porphyry occurs, and further along, at the source of the last considerable head of the Barama felsite is found. Hornblende-schist occurs in many places, and many huge masses of quartz, which do not appear to be auriferous, are found at intervals. These rocks are also noticeable in the valleys of the streams flowing into British Guiana, whilst on the Venezuelan side granitite and gneiss seem to be the characteristic rocks. The mountain range with its spurs appears to be the result of immense fissure eruptions through older formations of granite and gneiss, and on the northern and eastern slopes the rocks in many places lie exposed on a substratum of clay, derived from their decomposition, while to the south the land is generally free from rock outcrops. The slope towards the colony is nearly everywhere more abrupt than towards Venezuela."

The specimens collected from the Barima head, and from the high land which forms the boundary between British Guiana and Venezuela, are felsite, quartz-porphyry, and feldspar-porphyrite of types common in the colony.

The Barama River.—North-east of Anaturi, to its junction with the Waini, the course of the Barama River is through low swampy alluvial land covered with dense forest, but having in places low forest-clad hills, generally of red or ochreous gravelly clay, doubtless the degradation-product of either epidiorite or of diabase. Examples of such hills are those known as Captain Thompson's Hill and as Kobi's Hill. On the former hill are several blocks of white quartz, and on the lower ground to the south of the hill some enormous masses of quartz are exposed in the forest. The quartz is glassy, with a bluish tinge, and yielded no trace of gold upon assaying.

Below Anaturi schistose rocks which are much decomposed are exposed when the water in the river is very low. Between Anaturi and Woori Creek quartz is exposed in several places along the course of the river, the largest mass occurring a few miles above Anaturi, where it is exposed not only in the bed of the river but in great masses on the slopes of a low, forest-covered hill. The quartz is a quartz-schist, probably a modification of an originally felsitic rock.

Above the Woori Creek, and at intervals for about ten or twelve miles along the course of the river, much-altered rocks occur which are schistose in structure, light green in colour, and in places contain either crystals or rusty casts of iron pyrite disseminated through them. The rocks are highly metamorphosed and weathered porphyrite. The rocks seen to the north of Caman's Short Cut near Torobaru Creek are, as a rule, more schistose in character than those to the south of it. In places near here the rocks are altered to sericite-schist.

From near the Agawaris Creek to near Urinambu the river bends round the base of the Urinambu Hills. The rocks exposed in this stretch of river consist of epidiorite, and probably the high country in the neighbourhood is the same.

From the western exposure of epidiorite to near Wynamu Creek the rocks consist of more or less metamorphosed porphyrites, traversed in places by dykes of epidiorite.

From Wynamu to somewhat west of Cariacoo, near Kaikushie, the river traverses, for a distance of about six miles, a district of grey hornblende-granitite. Above this belt of granitite, as far as Monossi, the country is one of more or less foliated porphyrite and of schists derived from it. In places, as near Goring's Landing, low hills of red laterite indicate where bands of more basic rocks occur.

A narrow belt of grey granitite crosses the river near Monossi Creek. From this to a little beyond Mazawini Landing schistose porphyrites again occur, The strike of the foliation of the schists from Mazawini to Kaikushie varies from the north-east and south-west to east and west, while the general strike below Agawaris Creek is north north-west and south south-east. In many places the schists are traversed by veins and reefs of quartz-rock and of quartz-schist, which, as a rule, are not auriferous. Mazawini Landing is situated on a hill of red laterite. This is probably the decomposition-product of an epidiorite. The quartz-gravel in the laterite is auriferous.

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PLATE 10.

TOWAKAIMA FALLS

(OVER GRANITITE GNEISS),

BARAMA RIVER, NORTH-WEST DISTRICT.

Photo by H. I. Perkins.

From about half a mile above Mazawini Landing the river flows through a district of gneissose granitite and gneiss. The rocks for about four to five miles are mainly grey gneissose granitite. Above this the country consists of a fine-grained grey epidote-granitite-gneiss, which is traversed at the Towakaima and at the Mazawini Cataracts by veins and narrow belts of grey and pink granitite and of diorite. In places in this part of the district masses of amphibolite occur in the gneissose complex, and these may have given rise to the hills of red laterite which are not unfrequent.

The reaches of the Barama River above Towakaima Cataracts, as far as they have been examined geologically, traverse a country of more or less schistose porphyrite intersected by belts of hornblende-schist.

The Waini River.—There are some rocks and a small island, known as Granite Island, in the Waini River about a mile below the mouth of the Baramanni Creek. These are formed by a mass of grey granite, varying in texture from fine-grained to moderately coarse. On the left bank of the river, between three and four miles above Granite Island, another exposure of the granite occurs, while about seven to eight miles higher up the river, and about three quarters of a mile from its right bank up the Canayaballi Creek, huge masses of a coarser-grained variety of the grey granite are exposed. The low hills to the south and south-west of this appear to be of granitic origin.

These exposures of granite are of considerable interest, as true granite, consisting of orthoclase with some oligoclase, quartz, biotite and a good deal of muscovite, is of rather rare occurrence in the portions of the colony I have traversed; the only other localities known to me in which granite is found being near the junction of the Cuyuni and Mazaruni Rivers, on the upper reaches of the Pomeroon River, and above the lower cataracts of the Kuribrong River.

I have not visited the Waini River above its junction with the Barama. The following account of its structure is taken from pages 36 and 37 of Brown and Sawkins' geological reports, and, in my opinion—having examined their specimens from the Waini River petrographically—is probably accurate:—

"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 Anapiri 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 in crystals of over an inch in length; the feldspar is milk-white and of the same dimensions, while the mica is in crystals of one and a half 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 sand-banks at the bends of the river the plates of silver-white mica are to 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."

The Pomeroon River.—At Santa Rosa in the Moruca River, at Cabacaburi and at Macaseema in the Pomeroon River, there are low hills of laterite, over parts of the surface of which concretionary ironstone and blocks of quartz occur. These hills show evidence that the laterite has been derived from a foliated rock, in my opinion, probably an epidiorite or a hornblende-schist. Examinations of specimens collected in the higher reaches of the Pomeroon River by Mr. H. Rolleston in 1898, and by Mr. E. Beckett in 1906, showed that it traverses a gneissose country, which is intersected by rolls of a grey, somewhat gneissose granite. The Aranamai Creek, a branch of the Upper Pomeroon River, traverses a country of somewhat complex structure. Near Souarindu on this creek a micro-granite traverses the gneiss, and a silicified tuff—resembling the altered volcanic tuffs found on the Berbice River, and on the Potaro River, above the mouth of the Kuribrong River—occurs. At and near a place called Boatbuilder there are exposures of a fine-grained quartzite, of quartz-porphyry, of feldspar-porphyry, and of a somewhat fine-grained mica-gabbro, closely resembling the rock of the hill at the Barnard Placers on the Isenaro Creek of the Upper Mazaruni River. Near and at the Hiari Rapids on the upper part of this creek, exposures occur of an epidiorite, which in places is much chloritised, and the country consists, in part at least, of a mica-gabbro very similar to one which is found in the upper reaches of the Mazaruni River. The country is traversed by dykes of diabase. One of these at the Hiari Rapids consists of coarse-textured olivine-diabase, a variety of rock of relatively rare occurrence in British Guiana.

This country has not been prospected by gold-seekers to any extent, although its geological structure closely resembles that of the diamantiferous and auriferous areas traversed by the Mazaruni River below the Peimah Cataracts.

The Goldfields of the North-West District.—The principal gold-bearing area of the North-Western district is that near Warimba, Arakaka and Manikuru, which extends from the northern bank of the Barima River in a north-easterly direction, along the Kaituma Path towards the Kaituma River, and from the opposite bank in a south-westerly direction to some miles south of Hyma to the Barama River, between the landing at Mazawini and the Takutu Creek. This country consists of many more or less parallel ranges of relatively low hills with narrow intervening valleys, and it is intersected by numerous gullies and ravines.

The Warimba district is traversed by a range of diabase-hills, the rock of which is intrusive through a country of sericite, chlorite and actinolite schists, probably derived from the metamorphism of porphyrites and other rocks of intermediate composition.

The Arakaka and Manikuru districts are of similar geological structure. They consist of low ranges of hills of deep-red laterite, the surfaces of which are in places covered with concretionary ironstone and with quartz-gravel, whilst large blocks of quartz are frequently found on them. The valleys between the ranges generally are eroded into the schistose country, and contain alluvial deposits of very varying thicknesses, consisting of auriferous quartz-gravel intermingled with concretionary ironstone, and with small pieces of more or less decomposed schistose rocks, which are covered by ochrey-coloured layers of alluvial earths.

The general trend of the foliation of the schists and of the gneiss in the neighbourhood of the Arakaka district is north-east and south-west.

The hill ranges follow this general direction, and in many places along them great masses of diabase are exposed.

The bulk of the massif of the higher parts of the hills appears to have been diabase. But the numerous shafts sunk through the laterite, resulting from the decomposition *in situ* of the diabase, have frequently passed into dark-red laterite, showing a foliated structure, and in some of them—the Barr-Robertson Mine, the Barima Mine and the Gates Mine—the shafts have passed through more or less decomposing masses of grey rock showing foliation and which are altering into dark-red laterite. These masses have been found on petrographical examination to consist of an amphibolite or epidiorite, showing more or less clearly a commencing schistose structure, or which are in places—as, for instance, the country rock of the reef at the Barima Mine—well-marked actinolite-schist.

The laterites are therefore the products of diabase and of amphibolite, epidiorite and hornblende-schist.

In many places the altered rocks and their residuary decomposition-products, so common in this district, are traversed by reefs of auriferous quartz, and the residuary clays not unfrequently contain large quantities of more or less auriferous quartz, either in the form of angular gravelly fragments, or in that of narrow veins and intersecting threads.

The Five Star and Rocky River Goldfields are situated about thirty miles west of Arakaka, and are in a district of epidiorite and hornblende-schist, the workings being in laterite, and in the alluvial deposits resulting from it.

The auriferous district, situated mainly to the east of Hyma, and bounded roughly by the Takatu Creek, the Barama River, and the former line of the Barima-Barama Road, is similiar in structure to that of Arakaka, but the basic rocks are usually hornblende-schists.

Little appears to be known regarding the geological structure of the district between the Barima and Barama Rivers, with the exceptions of the parts where the goldfields situated between Arakaka and Mazawini landing are at present being worked. Judging from Sawkins and Brown's report (page 36 of the "Geological Reports") on the district traversed by them between Aranka, on the Barama and the Manarie Creek which flows into the Barima River, the structure of the country is similar to that of the Arakaka and Mazawini Goldfields. They noticed that the "greenish chlorite-schist" occurred in many places and in some localities is pierced by "grey trap dykes," while the soil dug up by armadillos is "invariably of a fine red colour." Examinations of the rocks collected by them show that their "greenish chlorite-schist" is the more or less schistose-porphyrite characteristic of the district, while their "grey trap" is diabase. As gold has been found and worked in the placers on the Sarawara Creek and on the Marakaikuru Creek, whilst we obtained colours of gold by washing the residual clays which form the hill at Koriabo, this line of country is probably similar to the Arakaka-Mazawini district in being more or less auriferous.

Near the Woorie Creek gold-workings are being carried on successfully in a district of sericite-schist.

A few small diamonds have been found in the southern part of the district near Ianna.

CHAPTER XIII.

THE LOWER ESSEQUIBO RIVER AND CUYUNI RIVER DISTRICT.

The northern part of this district resembles generally the corresponding part of the North-western District, and offers few features of geological interest.

The most northerly large tributary—the Supinaam Creek—of the Essequibo River is on its left bank, and its general geology is thus described by J. G. Sawkins:—

"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 siliceous matter by a process of segregation. Sands increase ascending the creek, and occur, in many instances, without any argillaceous admixture."

A few prospecting expeditions have reported finding colours of gold in the gravels of this creek. The higher ranges of land in the upper parts of its course probably represent off-sets from the northern extremity of the Blue Mountain range.

About 20 miles south of the mouth of the Supinaam Creek the Groete Creek falls into the Essequibo, on its left bank, in a part of the river characterised by the occurrence of extensive sandbanks, no rocks being exposed near its mouth. There are, however, some masses of quartz on the west or left bank of the Essequibo near Rock Island, about 9 miles north of the mouth of the Groete Creek.

The most northerly exposures of rock on the Essequibo River are near the left bank of the Ithaka Creek, which falls into the Essequibo River on its right bank about 4 miles south-east of the mouth of the Groete Creek. Great masses of a banded feldspathic gneiss of massive texture are exposed in the bush, while exposures of the same rock are seen on the right bank of the river near the Cable Station, and below Mr. Wilkie's house at Ithaka. The rocks were, at some previous time, quarried by blasting, and large quantities of them removed for use in the sea-defences on parts of the coast of Demerara. The close-textured massive rock, of various shades of pink and olive-green, is one of considerable beauty, and it is to be regretted that the structure of the coastlands prevents use being made of this handsome stone for public buildings.

Almost opposite to Ithaka, on the left bank of the river at Saxakalli Point, and somewhat further south at Karati Point, masses of quartz are visible near the edge of the river. This quartz is dark in colour, in parts schistose in structure, and contains in places small veins of earthy black oxide of manganese, and in others nests of massive psilomelane. Near by a shaft has been sunk in the hopes of obtaining graphite in payable quantities. No graphite was met with in the shaft, and masses of hard, gritty, black schistose material veined with calcite obtained from it proved on examination to be quartz, cemented and coloured by black oxide of manganese. On the top and slopes of the low hills in this vicinity boulders of white glassy quartz are scattered fairly frequently. The quartz from Saxakalli Point yielded upon assay 1·7 dwts. of gold per ton of the rock. Gneissose rocks are said to be exposed at Saxakalli at low water.

On the left bank of the Essequibo there are exposures of gneiss, generally a medium-textured grey variety, in many places between Saxakalli Bay and Gold Mine at Patientia. Near and at Patientia the banks of the river consist of decomposed gneiss, in places, having the appearance of stratified arenaceous and argillaceous earths. The layers are of many shades of colour varying from almost white and cream-coloured through buff and light-red, bright-red and dark-red to a cinnabar-like purplish-red. In many places, especially in certain of the deeper-coloured layers, the sandy ochreous earth contains abundant, very minute, scales of a glistening white, hydrous mica. If this earth is puddled in water the glistening scales separating out much resemble very minute globules of quicksilver; or, if the earth is rubbed between the fingers the mica scales adhere to them, and somewhat resemble floured or "sick" mercury. This has doubtless given rise to the rumour that there are deposits of cinnabar and of native mercury at Gold Mine, whereas the banks there consist of a decomposed basic mica-schist or gneiss.

The adit known as "The Gold Mine" appears to have been driven through similar material in the hopes of intersecting a quartz reef; and many fragments of quartz are found on the low hills near it.

In addition to the rumoured deposits of cinnabar and mercury, it is alleged that a seam of coal exists near Patientia. The foreshore of the river at and near Gold Mine certainly is rich in pieces of coal, and this mineral is present in some quantity in the shallow channel between Patientia and the Pairuwa Islands. But, besides coal, pieces of chalk-flints and other specimens, the origin of which, undoubtedly, has been ballast which has been thrown from ships, are fairly plentiful. The greater part of the coal has doubtless had a similar origin, many of the ships which load with timber in the vicinity arriving in the colony with cargoes of coal, and the remnants of these are thrown overboard whilst loading. There is, in addition, the wreck of a large ship in the river

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PLATE 11.

ESSEQUIBO RIVER AT DALLI.

The river at this point, 35 miles from the mouth, has a width of about $2\frac{1}{4}$ miles.

Photo by C. W. Anderson.

not far from Patientia, and parts of the coal may easily have been washed from her. Seams of coal nowhere exist in gneissose and granitic rocks such as form the country in this part of the Essequibo.

There are few exposures of rock on the right bank between Ithaka and Ampa. The rocky islets, known as Pigeon Islands, consist of granitoidal gneiss and of syenite, the western one, from which rock has evidently been removed by blasting, being a medium-textured grey granitoidal gneiss intersected by veins of pegmatite, while the eastern one is a mass of a somewhat coarse-textured basic hornblende-syenite.

At Ampa, five and a half miles south of Ithaka, a considerable area of gneiss, veined with pegmatite, has been opened up by quarrying. The gneiss is almost identical in character with the rock now being worked in the two large quarries at Dalli, about three-quarters of a mile south of Ampa. In these, the coarse-textured grey gneiss is seen to be traversed in various directions by numerous intersecting veins of pink-coloured pegmatite, containing large crystals of microline-feldspar, blebs and masses of quartz, and plates of muscovite-mica, some of which are one and a half inches across. The pegmatite-veins vary from an inch to perhaps two feet in breadth. Near the top of the northern quarry the gneiss is traversed by a vein of granite, varying from two to three feet in breadth, the rock being rather fine-grained and closely resembling the grey granite exposed at the Penal Settlement on the Mazaruni River. In some of the veins of pegmatite small dark-red garnets are abundant. The Dalli Islands consist of similar gneiss.

On the left bank of the river, between Patientia and Wolgar, a distance of a little over four miles, exposures of gneiss occur at intervals. The Wolgar quarries furnish instructive sections of the gneiss. Here the rock is of two varieties, a light-coloured feldspathic gneiss, and an almost black biotite-gneiss, approaching in character to a biotite-schist, and having a specific gravity of 3·00. Pegmatite-veins traverse both the dark-coloured and the light-coloured gneiss, the rock of the veins being as a rule white or pinkish-white in colour. In some of the veins crystals of orthoclase occur six inches in length and having well-defined faces. In places the pegmatite contains plates of dark mica, some of which are two inches in breadth. In the section shown in this quarry the biotite has separated from the bulk of the gneiss into masses having the high specific gravity noticed above. Having regard to the proximity of the great mass of granite which extends from near Wolgar to Akaio in the Cuyuni, a distance as the crow flies of thirteen miles, and for a similar distance to the southern extremity of Karia Island in the Mazaruni. It is probable that these biotite-masses are of secondary origin, and have been derived from rocks which are originally hornblendic. In places the veins of pegmatite gradually change by increase in the proportion of quartz and by decrease in that of feldspar into quartz-veins.

The islands known as Three Sisters in the river about three-quarters of a mile in a southerly direction from Wolgar, consist of medium to fine grained grey granite. For about a mile north of Makauria Creek, the rocks exposed on the right bank consist of granite, and this is well seen on both sides of the mouth of the Makauria Creek. In the rocks on the south of the mouth of the creek, caught-up masses of gneiss are noticeable in the granite. On this side of the river the granite-belt appears to be about one and a half miles wide, the character of the rocks exposed, and of the banks of the river to the south of it extending as far as Kamarihuru Island, eight miles south of Bartica, indicating a gneissose country. On the left bank of the river the exposures to the mouth of the Cuyuni consist of the grey granite. On and near the southern extremities of both Kaow and Calf Islands are exposures of rocks, consisting of the grey granite, with, in places, included caught-up masses of grey gneiss. The rocks near Bartica point, and for about a mile south of that point, on the Mazaruni River, consist of gneiss and of hornblende-schist, probably a local modification of the gneiss. To the north-east of Susan Island the grey granite occurs, and is exposed on the island and on other rocky islets in that part of the river. It is seen, veined with pegmatite, at the landing below the Commissioner's house at Kalacoon; in the quarries at Palmer's Point; at Barakara Cascades, and at Kyke-over-all Island.

The second of a series of small islands, opposite the northern boundary of the Penal Settlement, is largely made up of a mass of quartz, about forty feet in length of which is exposed at low water, whilst the small rocks in its vicinity indicate that the quartz occupies a somewhat extensive area. Assays show that this quartz at its outcrop does not contain gold.

At the large quarries at the Penal Settlement the nature of the grey granite is clearly seen. It is there traversed by veins of fine-grained granite and by many veins of pegmatite. The pegmatite contains small deep-red garnets and in places crystals of cloudy greenish-grey beryl.

The hill at the Penal Settlement consists of the residuary materials of a basic hornblende-granitite-gneiss underlain by the grey granite. At some earlier period the site of the Penal Settlement buildings was a small island surrounded by the waters of the Cuyuni and Mazaruni Rivers.

The Groete Creek.—Few rock exposures occur in the Groete Creek. About one mile west of the mouth of the creek, near the Indian village of Abanakari, on the right bank some masses of dark-coloured quartz are lying in residuary clays apparently derived from gneiss.

Rock exposures occur in the Groete Creek at about three miles from its junction with its tributary the Black Creek. For a distance of about one hundred yards rocks are exposed at intervals, consisting of gneiss traversed by a narrow intrusive vein of olivine-diabase. The banks of the creek, wherever clean sections are exposed, consist of the residuary clays from feldspathic gneiss. Beyond the exposures of gneiss the banks become lower, while the channel of the creek consists of siliceous sands. The course of the Groete Creek is mainly through a gneissose country.

On the left bank, a little below the mouth of the Black Creek, a small creek—Salt Creek—falls into the Groete Creek. This has its source in some low hills near the river, and a few small placers are being worked on the creek and its branches. The placer-gravels mainly consist of angular fragments of quartz with some ironstone-pebbles. Here and there in them oblong blocks of a more or less partially decomposed fine-grained hornblende-schist are found.

While the general course of the Groete Creek is from the north-east, its tributary creeks, the Black Creek and the White Creek, flow with very tortuous courses into it from a westerly and south-westerly direction.

The Black Creek flows in several places between its mouth and Black Creek landing over beds of ironstone conglomerate and ironstone gravels. These, as a rule, occur off spurs of higher ground which descend to the stream. About two miles, as the crow flies, from its mouth, and half a mile below the placer landing, there is an exposure on its right bank of a white mica-schist. The placers near Black Creek landing are worked in angular quartz gravels, and, like those at Salt Creek, contain in places in the gravel oblong pieces of fine-grained hornblende-schist or of epidote-hornblende-schist. About a quarter of a mile up the creek from the placer-landing, at a lock belonging to the wood-cutting grants further up the stream, a section is exposed in an excavation in decomposed gneiss. The lower parts of the cutting show in the residuary products well-marked signs of the foliation of the original rock, the layers being of various shades of red, brownish-red and yellow, while some are white ; in the higher part the signs of foliation disappear, the upper layers of the argillaceous earths becoming of a uniform ochreous hue caused doubtless by repeated deoxidation and reoxidation with attendant redistribution of the hydrated oxide of iron, upon the presence of which the colour depends. About a quarter of a mile above the lock large exposures of a dark-coloured augite-granitite occur. Similar exposures are seen in places for a mile up the creek, the rock varying in character from an augite-granitite to a hornblende-granitite. At one exposure the rock is intersected by veins of pegmatite about three inches across, which gradually change into quartz veins, and by thin veins or tongues of fine-grained grey granite. About half a mile above this an exposure shows a massive augite-granitite underlying a decomposing grey gneiss. About a quarter of a mile farther on, and for about half a mile along the course of the stream, grey gneiss of somewhat varying textures occurs. Near Matthew's wood-cutting grant masses of coarse-grained granitic-gneiss are seen, and these occur at intervals for probably from a mile to a mile and a half above the grant.

The Groete Creek and Cuyuni Trail.—This path commences at the placer landing on the Black Creek, and leads, in a general direction somewhat south of west, round and in places over the spurs of low hills, the heights of which vary from 150 to 200 feet above the level of the creek, to the group of placers on the White Creek near the foot of the hill termed by the gold diggers "Pull-and-be-damned Mountain," but formerly called by the Bovianders "Come-and-see Hill." The path crosses this hill, and after passing near some placers situated on the upper reaches of White Creek, ascends the Blue Mountain range, passes over its flat top at about 700 feet above the sea-level, and leads thence in a south-westerly direction over some of the lower spurs of the hills to the Groete Creek landing which is situated about five miles above the upper end of the Kamaria road on the Cuyuni River. The only rocks exposed on this path are, in the part of it leading from the Black Creek to the White Creek, chloritic and hornblendic schists with concretionary ironstones and gravels. The higher hills consist of hornblende-schist and of amphibolite varying in texture from fine to moderately coarse. The sides and tops of the hills are covered with ironstone-gravels, concretionary ironstones, and ferruginous sandstones and conglomerates. On the Cuyuni side of the Blue Mountain, near the foot of the hill, are exposures of well-foliated hornblende-schist and of fine-grained amphibolite. These are metamorphosed rocks originally of the gabbro-diabase type.

The Cuyuni River.—At Kartabo Point, at the junction of the Mazaruni and Cuyuni Rivers, a broad expanse of rock is visible at low tide; while near the point are several exposures of rock on the banks of the river, some of which have been worked as quarries. The rocks consist principally of grey granite like that at the Penal Settlement, but pegmatite or giant-granite is present in far greater abundance. In places good specimens of graphic granite may be obtained. Mica is present in the giant-granite, sometimes in large plates, while here and there red garnets are fairly abundant in the pegmatite-veins. A little to the westward of the road landing the medium-textured light-grey granite is seen with a glistening darker-coloured, fine-grained rock apparently intrusive in it. Both are traversed by veins of coarse pegmatite, which in places contain garnets. The fine-grained rock is seen, on microscopic examination, not to be an intrusive igneous rock, but a clastic sedimentary rock caught up in, and intensely metamorphosed by, the granite.

For about a quarter of a mile west from the point the right bank of the river shows here and there exposures of granite and of pegmatite, the latter frequently in various stages of decomposition. The granite is exposed at intervals for about two and a half miles up the Cuyuni River. A little below Arian Island a ridge of rocks crosses the river, and consists of square angular blocks of a very fine-grained light-coloured aplite containing here and there small garnets. Between this place and Batavia Island masses of the grey granite are exposed at intervals. At the point below Little Batavia Island the granite, which is here coarse-grained and veined with quartz, contains caught-up pieces of granitite-gneiss. The rocks below Batavia Island consist of fine-grained granite, and are succeeded by a belt of coarse-grained, while those at the lower end of Batavia Island are fine-grained. The rocks exposed on the small islands near the lower landing of the Kamaria Road are gneisses varying from hornblendic to feldspathic in

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Plate 12.

BOAT RUNNING RAPIDS ON THE

LOWER CUYUNI RIVER.

Photo by C. W. Anderson.

character. Similar rocks are visible at the landing, whilst on the road at about 150 yards east from the Manaribisi Creek, a dark-coloured epidote-biotite-gneiss, intersected by veins of pegmatite, and closely resembling the dark-coloured rock at Wolgar Quarry on the Essequibo, occurs.

The lowest rapid of the Cuyuni River, a tidal one known as Tatruba and as Patrick's Fall, is over an aplite very similar in appearance to that near Arian Island, and the same variety of rock occurs at the foot of Akaio Rapids, but is there veined with pegmatite. Towards the middle part of the Akaio Rapids the aplite assumes a coarser texture. Near the top of the rapids the aplite gradually assumes a somewhat gneissose structure, and by the development in it of biotite passes into a granitite. The coarse-textured aplite was noticed at Sauri, the succeeding rapids, where it is veined with pegmatite. Akawaio, Steil and Tuwarong Rapids are over granitite-gneiss, which at the former rapids is dark-coloured and fine-grained. At a small rapid above Akawaio the gneiss is coarse-textured and granitic, of a dark-green colour, with wide bands of lighter-coloured rock. From here to the foot of Crab Fall granitite gneiss occurs, its degree of foliation varying to a considerable extent. Kungler-Mamma Rapids are over a pink aplitic granite. At Smiths God Rapids a similar aplite, streaked by narrow veins of epidote, is exposed. The aplite varies in colour from pink to a greenish-grey, and here and there contains pieces of caught-up gneiss.

Matope Cataracts are over a belt of schistose gneiss, which is succeeded above the cataracts by a pink aplite-granite. At the cataracts in many places veins of the pink aplite traverse the gneiss, and a few narrow veins of a white muscovite granite are seen. These intrusions, in places, lie between and parallel to the foliation of the gneiss, and in others cut across the folia at varying angles.

The rapids above Matope are called Kettle Falls. The rocks in the river below the rapids are of a pink aplite, while the rapids are over a greenish-coloured gneiss intersected by veins of aplite.

The cataracts at Arikabusa-Boy are over coarse-textured grey gneissose-granitite with, in places, at the foot of the cataracts, caught-up masses of gneiss, while those at Arikabusa-Mamma are over gneiss. A small unnamed rapid below the Kamaria Rapids is over coarse-textured gneiss which extends to the lower part of the Kamaria Rapids. The rocks at the head of the latter are grey gneissose-granitite. Little Kamaria Rapids, which are the head rapids of the series of rapids and cataracts, are over a belt of very fine-grained grey granitite, which, in places, is traversed by veins of a darker basic rock.

This series of cataracts and rapids presents formidable obstacles to journeying up the river; and some of them are among the most dangerous to shoot of all those encountered in the reaches of the rivers of the colony which are more or less regularly traversed by gold diggers and other travellers. The series extends for about three and a half miles along the course of the river, the difference in level between the head and the foot of the rapids being about fifteen feet. As will have been perceived from the description, they are over a complex of gneiss, gneissose-granitite, and intrusive granites and aplites. The appearance of the majority of them is deceptive; only the low cataracts of Tuwarong, Matope and Arikabusa impressing the inexperienced traveller with a sense of danger. But the whirling rushes of water and the numerous backwaters at the lower ends of the various rapids are recognised by skilled boat hands as sources of many dangers. The loss of life in this part of the Cuyuni has been great, but, fortunately, the Kamaria road now offers an easy and practicable mode of avoiding the passage of the cataracts and rapids with its attendant portages and delays while going up the river, and its many dangers while descending.

Masses of amphibolite are seen in an ochreous-coloured ferruginous clay at the Upper Kamaria landing. About halfway between the upper and lower landings of the road near the foot of a steep descent rocks occur which, apparently, consist of a basic diorite, but which may be an amphibolite or epidiorite. Between the Upper Kamaria landing and a spot near the foot of Markabu Island rocks are not seen; but a little below the island is a rock of bluish quartz containing a few scattered grains of pyrites. At the lower end of the island there are masses of quartz exposed in the river, some of which are white and glassy in appearance, while others are pink. Between the island and the right bank of the river, and again at the head of a small island in the channel, are exposures of a dark-grey schistose-quartz. The quartz yielded upon assay gold at the rate of fifteen grains per ton of the rock.

On the right bank of the river near the mouth of the Oko Creek, and at the end of the Markabu Island opposite the mouth of the creek there are broad exposures of fine-grained, almost compact, dark-coloured hornblende-schist, with, in places, specks of pyrite, the rock varying in structure from massive to finely schistose. Similar rocks, showing upon weathering a well-marked schistose structure, are seen at intervals in the river from the Oko Creek to the lower end of Tiger Island, their schistosity being, in places, well marked. Above Tiger Island the bed of the river is occupied by a broad expanse of concretionary ironstone.

The landing for the Groete Creek path is situated on the left bank of the Cuyuni River about three-quarters of a mile below Tiger Island. As already described, this path traverses a country of epidiorite and hornblende-schists. Probably the Oko Hills, which appear to be a continuation of the Blue Mountain Range on the right bank of the Cuyuni, consist of hornblende-schist and amphibolite similar to those exposed on the path.

The only rock seen in the Mariwa Channel between the left bank of the river and Tiger Island, is a mass of white quartz. Assays showed that it contains only traces of gold.

The Government Station is situated about half a mile above Tiger Island on the right bank of the river. It stands on a hill about sixty feet high, the top of which is covered with a red earth with abundant ironstone-gravel, which in places contains large masses of milky-white quartz. The slope of the hill from the river consists of a white friable

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PLATE 13.

PORTAGING THE BOAT AROUND MATOPE CATARACT,

OVER GNEISS INTERSECTED BY ELVANS OF APLITE,

CUYUNI RIVER.

Photo by C. W. Anderson.

sericite-schist. Colours of gold can be obtained from the earth on this hill by washing, whilst near by placers are being worked in alluvial deposits derived from the sericite-schist.

The rocks exposed on the series of islands in the channels between which the Arawak Matope, Kumaka, and Mariwa Cataracts occur, are mainly gneissose granitites passing to granitite-gneiss.

Near the highest parts of the Portage at Arawak Matope, the rocks are dark-coloured and compact, and consist of hornblende-schist of specific gravity 2·89. The lower parts of the rocks, which are dark-greenish-grey in colour and have a greasy feel, show schistosity to a more marked extent, the planes being in some places approximately parallel to one another, in others crumpled into minute folds. The rocks are traversed by thin veins of secondary quartz, some of which show clear evidence of movement in the mass of the rock after their formation being broken by small faults. Near the main fall of the cataracts portions of the rock which have not undergone metamorphosis to the same extent as has the general mass are found among the schists. These have a specific gravity of 2·82, and appear to have been originally a feldspathic gabbro.

The rocks in Kumaka Rapids, in the channel next to the Arawak Matope channels of the cataracts, are of gneissose-granitite passing into more or less schistose-granitite-gneiss in the middle parts of the rapids.

The rocks exposed in a small fall west of the main Mariwa Cataracts have very well-developed schistosity, resemble slate in appearance, and are greenish-grey chlorite-hornblende-schists, containing specks of pyrites; and weathering to a rusty-looking earthy clay.

The main Mariwa Cataract shows a series of rocks of much interest. Below the foot of the fall the rocks are fairly compact, dark olive-green hornblende-epidote-schists, showing abundant small crystals and blebs of hornblende, and some specks of pyrite. The lowest rocks in the rapids below the cataracts are pale greenish-grey sericite and chlorite-schists with well-marked foliation, in places parallel, in others wavy. Ascending the cataracts the rocks become more massive and, the schistosity lessening, have more the character of gneiss than of schist, and may be termed hornblende-granitite-gneiss. At the head of the cataracts the rocks are in great rounded masses, in some of which the schistosity is only marked by occasional wavy streaks of hornblende, chlorite, sericite, epidote and biotite, while in other masses no signs of schistosity are seen. The macroscopically unaltered rock consists of granules of white and pink feldspar with interspersed blebs of augite and chlorite, and is an augite-granitite. The rocks exposed above the Mariwa Cataracts consist of a massive to a more or less gneissose-granitite. The Arawak Matope, Kumaka and Mariwa Cataracts furnish good examples of the changes of gabbro and granitite into hornblende-schist, hornblende-granitite-gneiss, and chlorite and sericite-schists.

The rocks above Arawak Matope, extending to the Simeri Rapids, consist of rather fine to medium-textured grey granitite. The Simeri Rapids are over a belt of very fine-grained, almost compact, dark-grey rock—a hornblende-mica-schist—which is traversed by intrusive veins of granitite. From here to the foot of the Mutosse Rapids, a distance of about a mile, the rocks are coarse-grained granitite-gneiss, resembling that seen above Mariwa Cataracts. At the foot of Mutosse is a fine-grained quartz-diorite. The rocks in the middle of the rapids consist of a compact microgranite, passing into a rather fine-grained granitite with abundant biotite. At the top of the rapids are intrusions of granitite through fine-grained mica-diorite. The structure of the rocks at Mutosse is that the fine-grained diorites are intrusive in the granitite-gneiss, and are themselves in turn intersected by veins of microgranite and of granitite.

The rocks from the head of Mutosse Rapids in the channels leading among the islands to the south-east of Swarima Island consist of a granitite of varying texture, and in the channels leading down to the Mariwa Cataracts, granitite occurs of the same character as that already mentioned as occurring at the upper part of the cataracts. In the main north-eastern channel are some great masses of glassy-white quartz, lying in a fine-grained gneissose granitite. About half a mile above this, the granitite is traversed by a narrow dyke of a dark-grey fine-grained amphibolite, which is probably connected with the fine-grained basic rocks seen at Mutosse Rapids in the south-western channel. Above this fine and coarse-textured granitite-gneiss and granitite are the prevalent rocks for about two miles.

In the south-western channel above Mutosse, at the foot of Takkarri Rapids, a fine-grained granitite is exposed, intrusive through a somewhat coarse-textured gneiss with marked wavy foliation, which is well seen near the middle of the rapids. At the head of the rapids a dark-coloured quartz-diorite is intrusive through the gneiss. On an island a little above is a large exposure of granitite-gneiss, where the gradual change in the rock from an apparently massive, coarse-textured granitite to a well-defined gneiss is very clearly seen.

Above this a dyke of a greenish-grey rock of specific gravity 2·86,—zoisite-amphibolite—crosses the river, and is intrusive in the coarse-textured gneiss, which is exposed at intervals between Takkarri Rapids and the foot of Swarima Island.

Near the lower end of Swarima Island a broad expanse of massive hornblende-granitite-gneiss is succeeded by fine-textured, and in places very basic, biotite-gneiss. About a quarter of a mile up the channel beyond the dyke of zoisite-amphibolite a broad belt of amphibolite forms the bed of the river, and extends to about 200 yards west of the Wariri Mine Landing. In places the amphibolite is altered to a talcose serpentine rock. As this only occurs to any great extent in the higher part of the masses of amphibolite, which are frequently exposed to the air, it is in part, at least, a result of weathering. A little above Wariri the amphibolite gradually changes to a very coarse-textured rock made up of large areas of white zoisite and patches of a pale hornblende, with occasionally blebs of somewhat opalescent quartz. In places the rock is finer in texture, but its mineralogical composition is the same. The specific gravity of the coarser variety is 2·84, that of the finer 2·95.

It is intersected by a vein of a greenish-grey massive granitoidal rock of medium texture, consisting of white zoisite with an abundance of a very light brownish-green hornblende, and having a specific gravity of 2·97. This rock closely resembles that of the dyke of zoisite-amphibolite which traverses the gneiss near Takkarri Rapids below the belt of amphibolite.

In the eastern channel, in a position corresponding to that where the belt of amphibolite occurs in the main course of the river, there is a small rapid, succeeded in the course of a mile or so by a long series of rapids and low cataracts known as the Upper Mariwa Falls and as the Akariwa Cataracts. Below the small rapid is a purplish-tinged mica-gabbro or gabbro, in which the masses of augite have been changed in places to chlorite and serpentine, and in parts to abundant plates of brown biotite by metamorphic action.

Below the foot of the long series of rapids is a dark-grey gneissose rock of specific gravity 3·08. This is related to the one just described, and consists in part of a fine-grained gabbro, and in part of a gabbro with the augite more or less completely replaced by green hornblende.

The foot of the rapids is over a fine-textured darker-coloured rock of specific gravity 2·97. In this the progress of metamorphism has extended farther than in the one last described, by far the larger portion of the augite being replaced by green hornblende, some large masses of the latter, however, have scattered through them numerous small kernels of unaltered augite. The rock shows clearly the commencement of schistosity. The middle and upper parts of the rapids are over a gneissose or schistose rock varying a good deal in texture, the finer-textured varieties having a specific gravity of 2·81, the coarser kinds one of 2·93. These vary mainly in their relative contents of labradorite, of epidote, and of hornblende, and represent the completely metamorphosed stage of the gabbro, being in places typical epidote-hornblende-schists.

The Akariwa Cataracts are caused by one of the spurs of the Blue Mountain Hills, as the Mariwa and Arawak Matope Cataracts are by other spurs.

In the western channel the zoisite-amphibolite band at Wariri, at about 200 yards above the mine landing, is succeeded by granitite-gneiss and hornblende-granitite-gneiss. A large reef of glassy-white quartz traverses the gneiss about half a mile above the landing, the quartz yielding to assay about twelve grains of gold per ton of the rock.

The Arimu Creek falls into the Cuyuni on its right bank about a mile west of Wariri.

About a quarter of a mile above the mouth of the Arimu are the Maritout Rapids. The lowest rock seen in these is a white mass of friable muscovite-granite. The rapids are caused by a belt of epidiorite passing to a hornblende-schist, probably an off-set from the broad belt of amphibolite, epidiorite, and hornblende-schists described as occurring near Wariri, and at the Akariwa Cataracts, and as giving rise to the Blue Mountains. At the head of the rapids the rock exposed is an epidote-hornblende-schist. Above Maritout a feldspathic gneiss occurs made up of pink and greenish-grey layers of feldspar and fine-grained quartz, and containing a vein of dark-grey quartz with specks of pyrite.

From Maritout to Stop-Off Rapids the country traversed by the river consists of somewhat coarse-textured granitite-gneiss with, in places, bands of diorite-gneiss. At Nosan Island the granitite-gneiss has a granitic character, and in hand-specimens has the appearance of a massive granite. Stop-Off Rapids are over a dyke of medium-textured olivine-diabase which strikes through the gneiss east-north-east and west-south-west, the dyke there being about 120 feet wide.

The eastern channel above Akariwa Cataracts traverses similar country—gneissose-granitite and granitite-gneiss—to that of the western. As a local modification about 2 miles above the cataracts a narrow band of muscovite-gneiss occurs.

About half a mile above the northern end of Swarima Island the north-east part of the dyke of olivine-diabase which, at the head of the western channel, gives rise to the Stop-Off Rapids, is exposed. The dyke is there about 50 feet across.

The Stop-Off Dyke is of considerable interest. It trends east-north-east to west-south-west, and is exposed, when the water is low, for nearly a mile across the river. It is broader in its western end than in its eastern, and appears to die out near the eastern bank of the river. It is composed of a somewhat coarse olivine-diabase of specific gravity 3·00. Olivine-diabase is a rock of relatively rare occurrence in the districts of the colony recently examined.

The river between Stop-Off Rapids and Tinamu Cataracts, which are situated about 3 miles to the north of the former, traverses a district of granitite-gneiss and gneissose-granitite. Tinamu Cataracts are caused by a diabase-dyke from 130 to 150 feet in breadth trending east-north-east and west-south-west. The rock of the dyke is fine-textured at its margins and somewhat coarser-textured towards the middle, where, in places, the diabase contains a little olivine.

The granitite-gneiss near the dyke has been much altered, the original ferro-magnesian minerals, in specimens taken from near the actual contact, being completely destroyed, and represented only by patches of minute grains of magnetite and of secondary augite, whilst the rock has assumed a granitic structure.

For about 2½ miles above Tinamu Cataracts the river flows from the west-south-west, and its right bank is below a low range of diabase hills which extends from Tinamu Cataracts to Tagina Point. The altered granitite-gneiss is exposed in places near the right bank; whilst at the mouth of the Moco-Moco Creek, about 1¼ miles south-west of Tinamu, diabase and altered gneiss are seen close together, although the actual contact is hidden. The granitite-gneiss is exposed at the mouth of the creek, and rather coarse-textured diabase a few yards up it. The former rock here has a micro-pegmatitic structure, and may be regarded as an altered granophyre. A few yards above Moco-Moco Creek a fine-grained variety of diabase occurs in the river, and near it are rocks consisting of profoundly altered granitite-gneiss.

At Tagina Point the river, which is about one-third of a mile wide at Moco-Moco, narrows until it is about 200 yards across. Tagina Point is a boss of fine-grained diabase intrusive through augite-granitite-gneiss. The granitite-gneiss is traversed by veins of coarse-grained pegmatite.

Above Tagina Point the river runs from the north for about 3 miles until its course is interrupted by the Paiyuka Cataracts. The rocks exposed in its course are near Tagina altered granitite-gneiss, about a mile above feldspathic granite, and near Paiyuka are altered granitite-gneiss.

The gneiss, about a mile below Paiyuka, contains a mass of pinkish sugary quartz, which is practically barren, yielding only at the rate of one grain of gold to the ton of rock.

The Paiyuka Cataracts are caused by a broad dyke, about 180 feet in breadth, of a fine-grained diabase trending west-south-west and east-north-east approximately parallel to the Stop-Off and the Tinamu Dykes. At Paiyuka the junctions of the diabase-dyke with granitite-gneiss are visible both above and below the cataracts. Here the gneiss is of a somewhat finer texture than it is at Tinamu and at Tagina Point, but is altered in the same manner. That from below the cataracts is more affected than that from above, the latter retaining some brown biotite not completely changed to magnetite and augite.

The rocks above Paiyuka Cataracts beyond the zone of altered granitite are gneissose-granitite and granitite-gneiss, and it is probable that the country between Tinamu and Paiyuka is a gneissose one, although the altered rocks do not show signs of foliation. The peculiar appearance of the altered granitite-gneiss in hand-specimens is very marked. At the foot of the Tinamu Cataracts it appears to be a granitoidal rock consisting of small white areas of quartz with abundant dark-grey to almost black crystals of feldspar, whilst the specimens from near the junction with the diabase at the head of the cataracts contain comparatively few of the blackened feldspars but many crystals of white plagioclase-feldspar.

Near Moco-Moco the rock consists of dark-grey to black feldspar crystals with abundant areas of pinkish-brown feldspar and of glassy quartz. At Tagina Point the granitite-gneiss is coarse-textured, and hand-specimens show signs of parallelism in its structure. The rock consists largely of whitish plagioclase-feldspar, a few plates of dark feldspar, blebs and patches of glassy-white quartz, and dull patches of a greyish-green augite.

The rock at the foot of Paiyuka Cataracts is very similar in appearance to that below Tinamu whilst that from near the junction with the diabase-dyke above Paiyuka is finer-grained, with abundant blebs and patches of glassy-white quartz, the feldspar-crystals generally having a greyish-green tinge, although some are white, and scales of a glistening bronze-coloured mica are scattered here and there in the rock.

The dark colour of the feldspar-crystals, which causes the gneiss to have in places the appearance of a coarse-textured basic rock—when first collected by the Boundary Commissioners it was thought to be gabbro—is due to the development of innumerable, very minute specks and inclusions, and especially exceedingly minute glass bubbles, throughout their mass.

The district between Paiyuka Cataracts and Quartz Stone—about 13 miles along the course of the river—is of granitite-gneiss, in places, as at about 8 miles above Paiyuka, with masses of glassy white quartz, or traversed by pegmatite-veins passing into quartz-veins.

At the western end of an island, about 1 mile east of the mouth of the Quartz Stone Creek, there is a great mass of white quartz containing numerous nests and needles of black schorl. The rock yielded upon assaying at the rate of one grain of gold per ton.

The course of the river, about 2 miles north-west of Quartz Stone, leaves the gneissose area. The more or less rounded masses of gneiss hitherto seen in the river are succeeded by angular and pointed masses of schistose rocks. These are metamorphosed porphyrites changed into chlorite and actinolite-schists with an average specific gravity of 2·90. They are well seen in the itabu below Pap Island, about 6 miles in a north-westerly direction from Quartz Stone. Near Pap Island the rocks are sericite-schists.

Above Pap Island the river crosses a belt of microgranite, the ferro-magnesian minerals of which are more or less completely chloritised. This extends to the Popekai Rapid, the lowest of the Topekai series of rapids. It contains in places, as between three and four miles above Pap Island, large masses of sugary-white quartz.

The great slab-like masses of rock exposed at Popekai Rapid, constantly through the Topekai Rapids, and at Mopay Rapid are hornblende-zoisite-schists. They appear originally to have been porphyrites and andesites.

Above Mopay Rapids there are large rounded masses of rock in the river. These consist of augite-granitite-gneiss, the rock is usually much chloritised, and in places contains calcite in nests and in veins.

Between here and the mouths of the Kopang and of the Waiamu Creeks the rocks are fine-grained, more or less schistose, feldspar-porphyrites. In places, as near Waiamu Creek, the rocks are altered and silicified, being changed to masses of quartz with a more or less well-defined schistose structure.

Similar rocks are exposed at intervals between the Waiamu Creek and the Waikuri Rapids. Here and there the feldspar-porphyrites pass into felsites and are generally much altered by weathering.

The rocks exposed at and for a little above Waikuri Rapids are augite-porphyrite.

Between Waikuri and the Akaiwong or Wakupang Cataracts the rocks are felsites and quartz-porphyries; they occur in places in rounded masses, but more usually in great slabs and more or less platy masses. The low hills on the right bank of the river consist of more or less decomposed felsite, quartz-porphyry, or feldspar-porphyrite. In many places the silica, which was set free during the decomposition of the rock has separated out as narrow veins of quartz.

Akaiwong or Wakupang Cataracts are caused by a broad dyke of diabase from 270 to 300 feet in width, trending through felsitic rocks west-south-west and east-north-east. The rock of the dyke is of medium to fine texture. At the upper side of the dyke the junction of the diabase with a much altered, very compact, silicified felsite can be seen.

Low ranges of hills trend from the left bank of the river at right angles (east-south-east and west-north-west) to the strike of the dyke.

Above and below the cataracts are extensive beds of sand and gravel, covered with coatings of ironstone-conglomerate.

The rocks exposed between Akaiwong Cataracts and near Anaripia Itabu, a distance of about 16 miles by the river, are felsite, quartz-porphyry, and feldspar-porphyrite, the latter in places passing into rocks having the structure of microgranite. Microgranite is the prevalent rock near Anaripia, in Anaripia Itabu, and near Pigeon Island.

The main channel of the river, when the water is low, is very frequently interrupted by extensive exposures of felsite and porphyrite in great rounded masses, surrounded by weathered slabs; in other places the felsite has a better developed schistose structure, and occurs in great upstanding slabs; and in some places the rocks have a slaty appearance, the felsite being either mylonitic or very markedly schistose.

About 3 miles south-east of the lower end of Anaripia Itabu, in the course of and near the right bank of the river for a distance of about 100 yards, a finely-bedded, fine-grained grit striking north 80° east and south 80° west is seen. This grit is a felsitic tuff, and is probably closely connected in origin with the outflows of porphyrites and felsites, some specimens of which upon microscopical examination show signs of having originally been andesitic lavas.

From a little to the west of the mouth of the Iroma Creek to near Peinkamarika rapids the rocks exposed are more schistose than are those seen between Akaiwong and Iroma, and are fine-grained chlorite-schists. In places the schists are veined with quartz or are replaced by quartz-rock, and occasionally they contain a fair amount of iron-pyrites.

The hills near the bank of the Cuyuni River in this part of its course are of decomposed felsite with here and there veins of secondary quartz. The gravels of the placers along the St. John's trail consist of quartz with numerous pieces of more or less decomposed felsite.

Peinkamarika Rapids are over a belt of hornblende-schist. Higher up the river this is succeeded by chlorite-schist which rock extends to near the foot of the Devil's Hole series of cataracts and rapids.

The Devil's Hole series of cataracts and rapids occurs over an area of gneissose-granitite, granitite-gneiss, and hornblende-granitite-gneiss, with intrusive belts and veins of granitite, of hornblende-granitite, and of aplite.

The lowest rapid of the series is over a zoisite-hornblende-schist. Above this for about half a mile the rapids are over gneiss of varying texture. The channels of the middle and upper rapids and cataracts are between and over great rounded masses of granitite and of hornblende-granitite usually showing a more or less well-marked gneissose structure. Arramarri or "Evil Spirits'" Cataract at the head of the series where the portage path crosses, is over a belt of granitite traversing granitite-gneiss.

The river above Devil's Hole portage and Arramarri Fall, as is usually the case where large falls obstruct the river course, expands to a great width, containing innumerable islands divided by wider or narrower and more or less shallow channels, the rocks exposed in which are mostly great rounded masses of gneissose-granitite.

About four miles above the Devil's Hole portage a vein of coarse aplite having a pegmatitic structure occurs. About a quarter of a mile beyond this some gneissose rocks, containing porphyritic feldspars conspicuously developed, are seen.

Immediately below Dukwarri Cataract gneissose-granitite exhibiting a marked schistose structure occurs, and Dukwarri Cataract is caused by a belt of hornblende-gneiss, about two hundred yards of which are exposed.

Above Paku Rapid schistose rocks again occur, and about two miles south-east of Dukwarri, at Pakutout Cataract a dyke of amphibolite is crossed for a distance of about two hundred yards.

For about two miles to the west from Pakutout the rocks in the channels between the islands are more or less schistose-felsites.

Above a small rapid (called St. John's) the river flows smoothly and slowly in deep channels between islands, and but few exposures of rocks occur for about three miles further up, where just below the foot of Kuyari Cataract is an exposure of diabase.

Kuyari Cataract, at the foot of the series known as Amamuri, is formed by a belt of compact gneissose porphyritic augite-granophyre.

The Amamuri series of rapids and cataracts descend over rocks of gneissose-granitite having an intrusive mass of granitite in the middle of the series, while near Powis Island, a belt of hornblende-schist extends across the river at the last rapid at the top of the series.

Above Amamuri is a curving stretch of fairly still water, extending about seven and a half miles along the river, in which only a few rocks, consisting of felsite-schist, are exposed.

At Otomung Rapid felsite-schist gives rise to a small rapid extending across the river in a west-north-western direction.

The rocks exposed in the river from Otomung Rapid to the Kanaima Itabu, at the many small rapids occurring through the course of this itabu, and also in the main channel of the river for about four miles above the upper end of the Kanaima Itabu, are generally felsite-schist. About two miles up the itabu from its mouth a belt of gneissose granitite occurs and gives rise to a rapid.

Rounded masses of gneiss and of gneissose-granitite again appear in the river for about four miles below, and also in the vicinity of the Akarabisi Creek.

About two miles above Akarabisi the rocks exposed consist of granophyre.

The Arimu.—The Arimu Creek falls into the Cuyuni River on its right bank about a mile west of Wariri. The rocks first seen in this creek near its mouth are contorted mica-schist. About a mile from the mouth masses of epidiorite occur, and other exposures are seen about a quarter of a mile further on. At a small rapid about fifty yards above these exposures, the massive epidiorite gradually changes to a foliated rock, and is succeeded by somewhat basic gneiss. About two miles from the mouth of the creek its course is interrupted by a low cataract. This is caused by a belt of compact hornblende-schist, containing abundant small grains of pyrites. It is intersected in places by veins of quartz, varying from mere films to tongues three or four inches in breadth.

The belt of hornblende-schist giving rise to the cataract, and the exposures of basic rock lower in the Arimu, are probably off-sets from, or are connected with, the Wariri amphibolite.

Exposures of granitite-gneiss are seen about a quarter to half a mile above the cataracts.

About two miles above the cataracts other exposures of granitite-gneiss occur, and continue at intervals until near Benjamin's Creek. During the fifteen miles above this there are no exposures of rocks, the banks of the creek being usually low, and consisting of white feldspathic clays. About two miles above Benjamin's Creek the Arimu cuts through some low hills of deep-red clay, having a well-marked foliated structure. These appear to be spurs of low hills, running more or less parallel with the banks of the Cuyuni River. The red clays are residues from the decomposition of epidiorites or hornblende-schists. About half a mile to a mile below the junction of the Little Arimu there are exposures of banded granitite-gneiss. Near the junction the creek cuts through a hill of red clay, similar to those seen in the lower part of its course.

A few exposures of gneiss occur in the Little Arimu Creek. The country traversed by the Arimu appears to be mainly a gneissose one, with, here and there, belts of basic intrusives, probably the sources of the gold in the placer-gravels near its banks.

CHAPTER XIV.

THE BRITISH GUIANA, VENEZUELA AND BRAZIL BOUNDARIES.

The British Guiana - Venezuela Boundary.—For about six miles west from Akarabisi, the Cuyuni River, along which the boundary is drawn, traverses a quartz-porphyry and porphyrite district, the rapids at Makapa being over the latter rock. Westward of Makapa, to the mouth of the Wenamu, the Cuyuni traverses the lowest beds of the sandstone-formation, although, in places, it has cut its channel through them into the underlying rocks, as at above Makapa, where these are epidiorites, at Arawatta Island, and near Amakaira Island, where proterobase is exposed, and at Eteringbang Fall, where the rocks consist of felsite.

In this long stretch of river the lowest beds of the sandstone-formation which are exposed consist of pudding-stones and coarse feldspathic grits, composed of re-cemented pebbles, gravels, sands, and silts of quartz-porphyry, porphyrites and felsites. Specimens of these were collected by the Boundary Commissioners from, at, and near the mouth of the Morawan Creek, in the neighbourhood of Eraki Creek, at Arawatta Village, Creek and Island, and at Mekura Rock. In many places the coarse-textured rocks are replaced by fine-grained feldspathic grits and mud-stones, these being of frequent occurrence in the neighbourhood of the Kuruni Creek, and westward from it. These fine-grained rocks are seen at Camp No. 1, at Eraki, near Waka Creek, and near the Maurugaru Creek. Slate Hill, east of the Kuruni Creek, consists of very fine-grained, finely laminated shale, and similar, but not so finely laminated rocks occur near Ekereku. At Kwia-kwia, and at Karapa, these feldspathic rocks are traversed by dykes of fine-grained diabase.

The rocks at the mouth of the Wenamu River consist of siliceous sandstone of medium texture. Near its mouth are large exposures of an augite-feldspar rock, of the tholeite type. The boundary-line follows the course of the Wenamu River in a southerly direction, and for many miles, to the Kura Falls. The only rocks seen are porphyries, porphyrites and felsites, which, in many places, and especially between Kukaraima and Tshuau, are intersected by numerous dykes of diabase. From the Kura Falls to the source of the Wenamu, the river traverses the sandstone-formation, which, in this neighbourhood, is intersected by numerous dykes of diabase, the latter rock being usually more or less coarse-textured, and tending to a granular structure.

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PLATE 14.

IRENG RIVER AND VALLEY

(BRAZILIAN BOUNDARY).

ABOVE THE TAWAILING MOUNTAINS.

Photo by C. W. Anderson.

The country to the eastward of the Wenamu is sandstone. The sections exposed on the Paruima Creek show that many bosses, sills, and dykes of diabase occur in it.

The boundary-line from the source of the Wenamu to Mount Roraima traverses the sandstone-formation. The lower slopes of Roraima consist of a fairly coarse-textured olivine-diabase. This is capped by sandstone, the mountain, apparently, being a dissected-out portion of a former sandstone-plateau, probably upraised, and resting upon a diabase laccolith.

The Brazilian Boundary and the Sandstone Plateau Districts.—Mounts Kukenaam, Roraima and Yakontipu, and the range of flat-topped mountains extending from Mount Yakontipu to and beyond the source of the Ireng River, are all of similar formation. They rise from an elevated plateau consisting mainly of quartz-porphyry and felsite with intrusions of granite, and, in places, as near the sources of the Kukui and Ireng Rivers, of gabbro. These rocks are traversed by numerous dykes, sills and other intrusive masses of diabase of very varying texture. The lower slopes of these mountains consist of diabase which in some cases, as at Yakontipu, forms the mass of the mountain. The upper slopes and the tops of the mountains consist of horizontally bedded sandstones, which cover and apparently butt against the igneous rocks. The beds of sandstone form caps on the tops of the mountains and broad terraces on their slopes. By processes of aerial denudation much of these coverings has been removed, and the remaining portions show great perpendicular escarpments, which at Mounts Kukenaam and Roraima rise in abrupt cliffs for heights of about 2,000 feet above their talus-slopes.

As far as has been ascertained the sandstones show few signs of contact metamorphism, but the diabase immediately below the sandstone-cap at Mount Roraima is of very fine texture, resembling the chilled outer parts of an intrusive mass, whilst the lower parts of the rock are coarsely crystalline. Probably these mountains are the results of laccolithic intrusions of diabase between the basal quartz-porphyry and the sandstones, and owe their very remarkable forms to subsequent aerial denudation.

In places, as in the vicinity of Chimepir and between Orindouk and the Tawailing Mountains, the sandstones show evidence of metamorphism, being traversed by layers of green and red "jasper" and by narrow veins of white quartz. Elsewhere the sandstone has been changed into a true quartzite or into a micaceous sandstone, an itocolumite closely resembling in hand-specimens a mica schist.

The sandstones extend southwards to the Tawailing Mountains, northwards to the vicinity of the Cuyuni River between the mouth of the Wenamu River and Makapa, and eastwards to the Merumé Mountains near the Mazaruni River, to Amatuk Cataracts on the Potaro River, whilst a narrow tongue of the formation crosses the Essequibo River, in the neighbourhood of Komuti Mountain, and stretches beyond it to the Berbice River in the vicinity of Itabru.

To the south of Echilebar the country consists of quartz-porphyry, gneiss, granites and gabbro, and is traversed in places by dykes and sills of diabase.

Between the Upper Potaro and the Ireng Rivers, and along the course of the Kopinang River, there are very extensive elevated flats, and, in places, mountains which are covered by concretionary ironstones, the country consisting of diabase. This rock there forms widely extending sheets and sills of great thickness. It is exposed along the southern banks of the Kopinang River for a distance of about thirty miles.

Extensive beds of coarse conglomerates occur in parts of the sandstone district, as near the sources of the Wenamu River, and in the Merumé, Kaieteur and Tawailing districts.

The sandstones in many places show a case-hardening to various depths by the deposition of quartz around their grains. The silica has doubtless been derived in part from the decomposition of the feldspathic constituents of the sandstones, but may also have been derived from the slow solution of some of the quartz grains. The case-hardening of rocks by the deposition of silica, which has been dissolved in rain-waters percolating through them, in the form of quartz, is not an uncommon occurrence in tropical regions, where during dry seasons evaporation from the upper parts and the surfaces of rocks takes place with great rapidity. The Kaieteur Plateau is an excellent example of this. The flattish rounded pebbles of white quartz which form the mass of the conglomerate are more or less etched on their upper surfaces where exposed on its bare flats, whilst they are so thoroughly cemented by secondary quartz in their matrix that it is frequently easier to break them across than to detach them from it.

There is a very remarkable development of this action in many places on the plateau which forms the top of Mount Roraima. The surfaces of shallow basin-like depressions on the summit of the mountain, which during wet seasons contain accumulations of rain-water, are covered with more or less horizontal masses of crystalline quartz, from which project into the water very numerous prisms of clear colourless or occasionally slightly clouded quartz, some of which are nearly one and a half inches in length.

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Plate 15.

CONGLOMERATE BEDS AT THE KAIETEUR PLATEAU,
POTARO RIVER.

Photo by H. I. Perkins.

CHAPTER XV.

THE MAZARUNI RIVER.

The first rocks seen on the right bank of the Mazaruni at Bartica Point, near the junction of the two rivers, Essequibo and Mazaruni, are of a light-grey, fine-grained granitite-gneiss, traversed by a broad belt of hornblende-schist, with frequently much contorted foliation. The schist is intersected by many thin veins of quartz, while in places it changes to a biotite-schist. The general trend of the belt of hornblende-schist is south-south-east and north-north-west, and frequent exposures of it and of the gneiss are seen on the right bank of the Mazaruni to near a point below Susan Island nearly opposite to the Penal Settlement. They are there succeeded by a broad belt of grey, medium to fine-grained granite with a somewhat gneissose character. This extends for a distance of about nine miles along the course of the river to the small rapids at Tutruba, and to near the southern end of Karia Island. The granite is exposed on several islands, and large and small rocks of it occur at intervals along the river; but its general character may be best seen in the quarries at the Penal Settlement, in Ansdell's quarry at Palmer's Point, and along the course of the Barakara Creek. It differs from the majority of the granites of the colony by containing fairly plentiful large flakes of original muscovite in addition to biotite mica. It is traversed by many veins of fairly coarse-textured pegmatite, one of which exposed near Kartabo Point, at the junction of the Mazaruni and Cuyuni Rivers, has the structure of a well-marked graphic granite. A large quartz-reef is exposed in the bed of a creek about a quarter of a mile from the banks of the river at Kalacoon. The quartz is auriferous, assays showing it to contain about thirty-six grains of gold to the ton of the rock. Near the north end of Karia Island on the right bank of the river are situated the abandoned shafts of the D'Urban Mine. These shafts were sunk through a red clay, probably the decomposition-product of either diabase or of hornblende-schist, to a rather fine-grained granite similar in composition to the rock at the Penal Settlement and at Ansdell's Quarry. In the bed of a creek near the shafts veins and masses of white, glassy, barren quartz are seen.

The rapids at Tutruba are small ones, over very fine-grained grey granitite-gneiss. Gneiss is very well seen at Brickbroke Rapids, Marshall Rapids, Kesterbrake Rapids, Warimambo Cataracts, Ishpot Rapids, Mapishako Rapids, near Ikurishi Creek, Kasira River, and at Kwapanna Rapids, Mapituri Rapids, Español Cataracts, Tarpé Rapids, Crab Rapids, and at Yapemu Rapids in the left channel. The general character of the gneiss is medium to fine in grain with numerous veins of pegmatite intersecting it in all directions. The pegmatite, as seen at Marshall Rapids, at Kesterbrake Rapids, and at Warimambo Cataracts, is frequently of a very coarse texture, showing white and pinkish-coloured feldspar-crystals from three to four inches in length. Above Iren Rapids the gneiss is of a coarser texture than it is at the lower rapids of this series. At Stile Rapids the gneiss is intersected by a coarse-textured, grey granitite containing blebs of bluish opalescent quartz. At Tarpé Rapids, near the left bank of the river, the gneiss is traversed by a dyke of fine-grained diabase, about seven feet in width, which strikes approximately south-east and north-west across the left channel of the river.

From Maripa Cataracts, at the head of the series of cataracts over gneiss, the river for about three and a half miles flows through a belt of gneissose granite. In this the channels of the river follow very tortuous courses between numerous small islets and innumerable rocks. At Maripa Cataracts the granite is a coarse-textured, pinkish to grey granitite which is traversed by a few veins of pegmatite, usually from one to two inches in width. Above the Maripa series of rapids and cataracts are the Popikai Rapids, where the rocks exposed consist of an epidote-hornblende-granitite, with a marked gneissose structure approximating to that of a granitoidal gneiss. which later gives place to a pink-coloured, medium-textured granitite. Some immense rocks and masses of the coarse granite near the lower parts of these rapids are known as the Popikai Rocks. The next series, the Yamatuk Rapids, are over coarse-grained, grey granitite, which is traversed by a very fine-grained, pinkish granitite lying in intrusive sheets. Near the Yamatuk Rapids attention is drawn to a weathered mass of granite roughly resembling a horse's head, called the Yamatuk Rock.

Somewhat higher up the channel than the Yamatuk Rock on the left bank is the lower end of Wassai or Tramway Hole, a narrow channel through which the water rushes with great force and at a high velocity. The lower parts of this channel are cut through granitite, the upper part through coarse-textured hornblende-granitite-gneiss intersected here and there by veins of fine-grained granitite. In the main channel, above the lower end of Tramway Hole, the Tokaima Rapids occur over granitite, while above its upper part, at Kumana Rapids, and at near its head, great rounded masses of fine-grained, grey granitite-gneiss are seen. For about three miles and a half above Wassai Hole the channel is cut through granitite-gneiss.

Near Kapasi Mission Station (now abandoned) and at Kapasi Rapids, south of the station, great rounded masses of coarse-grained hornblende-granitite are exposed; the same rock occurs at and near Pikaima Island, and also at several small rapids, while here and there along Tupeku Channel a finer-textured variety is seen. About a mile and a half up this channel a dyke of dark-grey, fine-grained quartz-diorite, varying in breadth from five to ten feet, was noticed intersecting the hornblende-granitite. The belt of hornblende granitite is about four miles in width. From a little south of the dyke of quartz-diorite exposures of quartz-diorite-gneiss occur at intervals for about a mile and a half, and extend to the foot of the Tupeku Cataracts.

The Tupeku Cataracts are caused by a belt of an amphibolite and hornblende-schist from three to four hundred yards wide. The general strike of the foliation of the hornblende-schist varies between south 54° west and south 82° west, the foliation dipping at high angles of from 60° to about 75°, but in places the planes of foliation are almost vertical, while in others they are highly contorted. The dark-coloured hornblende-schist contains many thin veins of quartz with grains of arsenical pyrites. In places narrow bands of amphibolite are seen with but little foliation, while here and there narrow, lighter-coloured bands of schist occur. Through the hornblende-schist and the amphibolite many intrusive tongues of pinkish granitite and of white muscovite-granite are noticeable. At the head of the cataracts are exposures of epidote-granitite-gneiss, followed by a narrow belt of hornblende-schist. The fact that the granitite of the district is more recent than the hornblende-schist and gneiss is very clearly shown at these cataracts.

From Tupeku Cataracts to Makari Rapids the country is a gneissose one. The gneiss is well seen near Poke Island and at Mary Rapids, while in the channel above these rapids a narrow tongue of quartz-mica-diorite traverses it. At and above Itaballi Rapids the gneiss exposed is very contorted, and consists of bands of light-coloured granitite-gneiss with dark, almost black, glistening ones of diorite-gneiss. For about a mile and three quarters above the head of Tamanua Hole the river flows through a plexus of islets, and is constantly interrupted in its course by cataracts. Near the small island, known as Sam Island, is a large boss of a porphyritic diorite having very abundant crystals of hornblende, usually from one to one and a half inches across.

Sapira Rapids occur a little above Sam Island, followed at short intervals by Parawakas Cataracts, and by Paraimah Cataract and Caburi or Yanissaec Cataract. The rock exposed through this series of rapids and cataracts is generally a banded gneiss, the layers consisting of granitite-gneiss, hornblende-granitite-gneiss, in places of a greenish epidote-granitite-gneiss, with here and there narrow layers of diorite-gneiss. Many tongues and dykes of intrusive rocks occur in this neighbourhood. At Sapira Rapids the gneiss is intersected by tongues of aplite, of granitite, of a quartzose felsite, and by a dyke varying from eighteen to twenty-four inches across of mica-diorite. At Parawakas Cataracts, where the country rock is a banded hornblende-granitite-gneiss, narrow tongues of granitite traverse the rock, which is there seamed with many narrow veins of jaspery-looking quartz. The Yanissaec or Caburi Cataracts are over a banded granitite and epidote-granitite gneiss, which below the main fall is traversed by a dyke, trending north-north-east and south-south-west and which is about one hundred and fifty feet in breadth, of a close-grained epidote augite-syenite, the northern portion of the dyke being of very compact rock.

This dyke divides near the cataracts into one of about one hundred feet in breadth, of medim texture, trending north and south, and into a narrower one of far more compact texture striking north-north-east and south-south-west. On the north side of the main fall at Caburi Rock, the gneiss is traversed by a dyke of mica-diorite, by veins of a pink granitite, and by others of a greyish epidote-granitite, whilst it is intersected by narrow veins of pegmatite showing small grains and patches of galena and of chalcopyrite. A little above the Caburi Cataract a narrow elvan of epidote-augite-syenite strikes east and west through the gneiss.

The channel above Caburi Cataract runs between numerous small islands until at Mora Rapids, about a mile from the head of the cataract, numerous rounded masses of gneiss occur, which are similar in structure to that at and below the cataracts, and are traversed by veins of an intrusive micro-granite. The Mora Rapids extend at intervals for about half a mile to the Little Mora Rapid, and to the rapids known as Little and Big Haiowa, where, at the lower ones, the gneiss is intersected by a narrow belt of granitite succeeded by a broad expanse of granitite-gneiss, which shows at the head of Big Haiowa Rapids a somewhat obscure foliation.

Above the Big Haiowa Rapids the channels of the river wind through the Makari Cataracts and Rapids. The cataracts are in a belt of augite-syenite, which is intrusive through the gneiss, and of which there are two varieties, a very coarse-textured, in part porphyritic kind with, in places, large phenocrysts of colourless orthoclase, up to one and a half inches in length, thickly scattered through a white matrix with many brownish-yellow crystals of pyroxene and here and there with tufts of small yellow crystals and a close-textured, almost compact, rock of similar composition. The Makari Rock, a huge isolated mass weathered in an extraordinary manner and characterised by its ragged, jutting outlines, consists of the former variety, and rests upon a bed of the latter, which, weathering with rounded outlines, extends for about a quarter of a mile along the course of the river.

The Makari Rapids, which extend for a long distance, are over granitite-gneiss, which is the prevalent rock along the river for many miles, from here to the Turesi Cataracts. Above Makari Rapids the course of the river, although winding between islands, is fairly free from rapids, the channels being termed by the boat-hands "still-waters." Near the lower end of Koimara Hole, a channel commencing about two and a half miles above the Makari Rapids, is a narrow dyke of diabase (altered to proterobase) striking through the gneiss from north-east to south-west. About a mile and a half from this dyke, near the head of Koimara Hole, a belt of red granitite intersects the gneiss for about four hundred yards. Its course is not interrupted by rapids to any noticeable extent through the reaches above Koimara, but gneiss is well-seen at Haiowa Island, at some small rapids a little above that island, and at Kusawe Island. Kusawe Cataract and Rapids are caused by a narrow belt of granitite, some two hundred yards of which appears to be traversed by the river which here flows from the south.

Above Kusawe Rapids the river winds through a gneissose country for a long way, the length of this part of its course being about twenty-five miles. Above Kusawe Rapids the gneiss is traversed a little above the rapids by a narrow dyke of diabase, changed locally to proterobase; and about three-quarters of a mile from the rapids a dyke of diabase of medium texture is exposed for about one hundred and fifty yards, striking in a north-east and south-west direction through the gneiss. At the lower end of the channel called Karawarambo Still-water, a dyke of diabase strikes through the gneiss in a direction of about north 10° west and south 10° east. Several broad exposures of the gneiss occur in Karawarambo Rapids and channels and in Pakaburi Rapids, Hole and Channel. At the head of Pakaburi Channel, near the foot of Little Itaki Rapids, a dyke of diabase about five feet in breadth traverses the gneiss, striking north and south. In this neighbourhood the striking differences in the manner of weathering of gneiss of different structures is well marked—the coarser-textured parts altering into great rounded knobs or bosses, the finer ones forming low hummocks, in places, with very rough surfaces resulting from the partial weathering of the rock and the re-cementation of the *débris*.

Near Little Itaki Rapids (Itaki-boy Rapids) coarse-textured hornblende-granitite-gneiss shows in places intrusive tongues of very fine-grained, dark-coloured hornblende-granitite. At Itaki Cataracts, about a mile above Itaki-boy, is a very broad exposure of gneiss, the rock generally being granitite-gneiss, but in places being medium to coarse-textured hornblende-granitite-gneiss, with here and there almost a granitoidal appearance. The gneiss is traversed in places by narrow veins of granite and of aplite. About a mile above the head of these cataracts the gneiss is traversed by two narrow dykes of diabase, each from ten to twelve feet across, and with parallel trends to the north-east and south-west. Near the mouth of the Puruni at Kumbiri Rapids a dyke of diabase about thirty feet in breadth is seen for a distance of about two hundred and fifty yards, striking north-north-west and south-south-east through gneiss. The edges of this dyke are very compact in structure; and the joints in places are coated with films of arsenical pyrite. An off-set from this dyke about five feet in breadth strikes to the east-north-east near Flat Rock Island, and at Bird Island Rapids, just below the mouth of the Puruni, a dyke of diabase trends through gneiss in the direction of north-east and south-west, apparently varying in breadth from twelve to eighteen feet.

Between the Puruni and Kurabiri Cataracts the channel passes between many large hummocks of gneiss, which rock is traversed at Kurabiri by a dyke of dark-coloured, medium-textured diabase about twenty feet in breadth and trending north and south. Two off-sets from the main dyke strike parallel to one another to the east and west, one varying from six inches to four feet in breadth, the other from three inches to one foot, the rock of these veins being of very fine texture and of a lighter shade than that of the main dyke. Frequent exposures of gneiss occur between Kurabiri and above the head of the Kabuwira Cataracts, the rock being well seen near the Pacapoey Rapids. At Kabuwira the gneiss in the lower and upper cataracts is very feldspathic with little mica, while that in the middle parts is dark-coloured granitite-gneiss showing well-marked foliation.

A little distance above the head of Kabuwira several dykes of diabase occur; the first one being forty feet in breadth and striking north-east and south-west, a second, a narrower one, trending east and west, and a third traversing the gneiss in the direction of east-south-east and west-north-west. About one hundred yards higher up the river a dyke of the same rock strikes north 60° west and south 60° east, and another about sixty feet across trends to the south-south-west and north-north-east. Near the foot of Itaballi Rapids, about a quarter of a mile from the head of Kabuwira, a diabase-dyke runs in a direction somewhat north of east through granitite-gneiss, and gives rise to a small island, while at the head of the rapids a dyke of diabase about sixty feet in width strikes north-east and south-west, and after passing through a small island splits into two dykes; above here diabase is exposed at intervals on three small islands, and apparently gives rise to a small rounded hill on the mainland near the right bank of the river.

About half a mile beyond the head of Itaballi Rapids great masses of glassy, white quartz are exposed in the gneiss. The samples collected yielded gold upon assay at the rate of seven grains per ton of the rock. About three hundred yards above the masses of quartz a diabase-dyke strikes south-north-west and north-north-east. A little above a reef of white, sugary quartz, seen for a length of about twenty feet, runs north 80° west, is about five feet in thickness, and dips at an angle of nearly 70° through gneiss. Samples yielded upon assay nine and a half pennyweights of gold per ton of quartz. Somewhat to the east of this two smaller exposures of quartz occur which probably are portions of this reef.

Kartauari Cataracts are about five miles higher up the river. The river flows with great velocity through the channels below them, and is, in places, interrupted by small rapids. For the first two miles of the channel the rocks exposed consist of granitite-gneiss and of coarse-textured, almost granitoidal, hornblende-granitite-gneiss, the latter being traversed, near a series of small rapids, by a narrow vein of diabase. The hornblende-granitite-gneiss is of a reddish colour, and weathers either into rough jagged masses or into large pointed pinnacles. Below Kartauari Cataracts the gneiss is a fine-grained granitite-gneiss, with well-marked foliation, and is traversed by a broad belt of augite-granitite or quartz-monzonite. This has given rise to many great masses of rock weathered into extraordinary shapes, several of them having striking resemblance to gigantic crouching toads. Of these, the largest and most remarkable is the one situated near the right bank of the main channel, called the Kartauari Rock. This rock and the rounded

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PLATE 16.

PITTED CONCENTRIC WEATHERING OF DIABASE ROCKS, TURESI CATARACTS, MAZARUNI RIVER.

Photo by H. I. Perkins.

masses near it, consists of a porphyritic granitite with many large pink phenocrysts of alkali-feldspar, and which contains augite and hornblende in addition to biotite. The porphyritic rock is traversed by veins of much finer texture having a similar composition. Near Kartauari Rock the granitite is traversed by a narrow dyke of diabase. Many of the granitoidal masses near here show a somewhat gneissose structure. The Kartauari Cataracts are, in parts, over granitite, and, in others over gneiss, the latter varying from ordinary granitite-gneiss to hornblende-granitite-gneiss, in places with much epidote. About half a mile above these cataracts a vein of aplite traverses the gneiss. From Kartauari to Turesi Cataracts, a distance of about three miles, the country is a purely gneissose one, the rocks being varieties of granitite-gneiss, varying much in texture, and in their contents of dark-coloured minerals, some large rocks about a quarter of a mile below Turesi being almost free from them, the little biotite present in them being in small orbicular patches.

At Turesi, where the river for a short distance both above and below the cataracts is free from islands, so that its full breadth of about half a mile is seen, and for the first time after passing the northern end of Karia Island, a few miles south of Bartica, both its banks are visible at once, the Mazaruni is crossed by a very broad dyke of diabase, which is over two hundred yards in width. The rock is of uniformly medium texture, and it has many remarkable pot-holes, frequently of large size, eaten into it. Both the vertical and the horizontal surfaces of many of the great masses of diabase which stand out from the bulk of the rock are pitted with large and small basin-shaped depressions, which probably result from the rock flaking away from the effects of the very great changes in temperature between the afternoon, when the blackish rock becomes too hot in many places to allow the hand to touch it, and after nightfall, when its temperature becomes very rapidly reduced by radiation. The strike of this great dyke is north-east and south-west. The contents of some of the pot-holes in the diabase at Turesi Cataracts were examined, and were found to consist mainly of quartz-gravel and sand, with a few fragments of felsite, and very many grains of ilmenite. Several pot-holes were emptied of their contents, which were washed, and in each case yielded colours of gold.

Above the cataracts the first great exposures of rock consist of epidiorite passing to hornblende-schist; above them exposures of epidote-granitite-gneiss occur, followed by many large rocks consisting of amphibolite; and by masses of augite-granitite-gneiss and of granitite-gneiss, alternating with amphibolite. Above the Turesi Cataracts the river is again crowded with islands. On the right bank, about a mile above the head of the cataracts, a broad exposure of diabase extends for about three hundred yards. South of this the rocks are in low, rounded masses of coarse texture, and consist of quartz-diorite, an epidiorite traversed in places by narrow tongues of diabase. The river is here crossed by a dyke of diabase trending to the south-west from the mass on the right bank. A reef of quartz strikes north 10° east and south 10° west, in the epidiorite, near the diabase dyke; and about twenty-five feet in length with a breadth of about two feet of it is visible. Samples taken from it yielded, when assayed, at the rate of fifteen grains of gold to the ton of rock. Near the left bank of the river are great masses of glassy, white quartz, with somewhat contorted structure, apparently parts of a vein striking north-west and south-east, whilst near by is another reef trending north-east and south-west, both being in very coarse-textured quartz-diorite. Samples from these veins yielded at the rate of twenty-six grains of gold to the ton of the quartz. A little above these latter exposures of quartz a narrow dyke of diabase trends east and west through the quartz-diorite. During the next mile of the course of the river many exposures of the latter rock occur, in one place being traversed by a dyke of fine-grained diabase largely altered to proterobase, the dyke being about ten feet in breadth and trending south-east and north-west. Near it an intrusive vein, about eight inches in breadth, of a micrognanite, having a fluxion structure, traverses the quartz-diorite. A quarter of a mile from here a diabase-dyke strikes east and west through epidiorite, near where are some small exposures of quartz; beyond this another narrow dyke of diabase strikes north and south. Exposures of fine and of medium-grained epidiorite occur, followed by rounded masses of coarse epidiorite, with an intrusive tongue of diabase through it from a dyke trending north-west and south-east.

About half a mile further up the river the epidiorite is succeeded by a band of a hornblende-gneiss containing many blebs of bluish, opalescent quartz. For about two miles the epidiorite has a more or less gneissose structure, and in one place it is intersected by a narrow dyke of diabase, about four feet in thickness, with a strike of north 20° east and south 20° west. Near the dyke the epidiorite is generally of compact texture, and has weathered into angular masses. About four hundred yards beyond this dyke a narrow vein of quartz, trending north 50° east and south 50° west, is seen in the epidiorite. Above here the epidiorite is traversed by a dyke of diabase, about twenty feet in breadth, striking north-east and south-west, and from this there is a narrow offset of fine-grained diabase. Alternations of coarse-textured epidiorite, more or less gneissose, and of a fine-grained, compact variety, extend over the course of the river to near the end of the Tamanua Channel. These are traversed in places by narrow dykes and veins of fine-textured diabase, and towards the end of the Tamanua Channel by two dykes of the same rock, each about eighteen feet in thickness, striking, parallel to one another, in an easterly and westerly direction.

In the district extending from Turesi Cataracts to the Marabisi Channel, the more feldspathic parts of the epidiorite or quartz-diorite generally weather into rounded masses, and in places give rise to somewhat extensive low rounded hummocks, while the more hornblendic and basic portions give rise to angular rocks, blocks and boulders.

At the lower end of the Marabisi Channel, or still-water, the course of the river is fairly free from islands, and not interrupted by rapids, its width being about six to seven hundred yards. In places, when the water is low, large sandbanks are exposed in the channel. The rocks at the eastern end of the channel are fine-grained hornblende-porphyrite and epidiorite traversed by a diabase dyke, the rock of which is of medium texture and is in part altered to proterobase. The direction of this dyke is north-east and south-west. The epidiorite is succeeded by a greenish-coloured chlorite-schist, with abundant small cubical crystals of pyrite disseminated through it. Near the south-west end of an island, about half a mile east of the mouth of the Issano Creek, there is a quartz-reef, traversing greenish-coloured well-foliated chlorite-schist, of which about sixty yards in length is seen trending generally north 20° west, and south 20° east. The main reef varies in width from three to six feet, and on the shore of the island thickens out to from ten to twelve feet, whence it throws off two branches, one to the south-east about eighteen inches across, and one to about south 40° east of nearly the same thickness. While crossing the northern channel of the river the reef splits, the main part of it continuing to strike to north 20° west and the smaller off-set to a little west of north. The quartz of these reefs and veins is glassy and is veined, parallel to the walls of the reefs, by thin layers of greenish-black tourmaline. Samples of quartz from different parts of the reef were assayed and yielded at the rate of three pennyweights of gold to the ton of the rock. Several exposures of the chloritic rock, more or less markedly foliated, occur between this island and the mouth of the Issano Creek.

For some distance above the mouths of the Issano and of the Marabisi Creeks many large sandbanks are exposed, at times, along the course of the river, especially near its right bank. About two miles above Issano Creek masses of quartz-schist strike across the river from the north-west to the south-east; other masses are seen about three hundred yards from the first, and a third lot is visible about five hundred yards from the second. The quartz-schist is probably a local modification of a quartzose-felsite. Between the second and third exposures of quartz-schist rocks occur on the left bank of the river, which are of quartz-porphyrite. Near the south-west end of this island there are several exposures of more or less schistose fine-grained hornblende-porphyrite. At the end of the Marabisi Channel, where the course of the river turns from the west, a belt of porphyrite extends across the river in an east-north-east and west-south-west direction, about thirty feet in breadth being exposed above the water, and here the rock has a well-marked rectangular jointing. On the north point of the river bank at this bend there are numerous great masses of concretionary ironstone, evidently derived from a hill of diabase at the point. From about half a mile from this point exposures of feldspar-porphyrite extend at intervals for about two miles. At about a mile and a half from the first exposure of feldspar-porphyrite, near the left bank of the river, large rounded masses of a coarse-grained epidiorite are seen in contact with fine-grained porphyrite. The epidiorite contains many small nests of quartz, while the porphyrite is frequently intersected by thin veins of the same mineral. Further exposures of porphyrite occur along the channel of the river to near where its course changes from the south-west to the south-south-west.

From this point to the Tiboku Cataracts is a distance of about seven miles. Near the turn to the south-south-west, the channel of the river is crossed by a wide dyke, about fifty yards in breadth, of coarse-grained diabase, running north-north-east and south-south-west. About a quarter of a mile above this dyke many rocks are seen, consisting of fine-grained granitite-gneiss, while similar rocks, varying in texture from fine to cross-grained, occur for about two miles and a half. Towards the middle of this belt of gneiss the rock is a syenite-gneiss, changing to a hornblende-granitite-gneiss near the southern end. Through the latter rock a narrow vein of fine-grained hornblende-porphyrite is intrusive, and some yards further, a dyke about twenty-five to thirty feet in width of a porphyrite-diorite crosses the river from north-north-west to south-south-east. The dyke, which is intrusive through a coarse-textured hornblende-granitite-gneiss, has an interesting structure; in the middle parts the very abundant hornblende-phenocrysts are short and stumpy, and have more the general habit of augite crystals than of hornblende; whilst near the edges the hornblende has the form of long, relatively narrow, prisms. The outer parts of the dyke, in places, show thin veins of epidote traversing the rock.

For about a mile and a half south of this dyke the rocks are coarse-grained hornblende-granitite-gneiss and finer-textured granitite-gneiss, and are intersected at about a mile from the dyke by a narrow vein of diabase with an east and west trend. Near the south end of the belt of gneiss a very fine-grained gneiss or schist consisting largely of quartz and muscovite occurs on a small island.

Beyond the gneissose rocks the course of the river is cut through quartz-porphyrite, and this is the only rock seen below Tiboku Cataracts. These cataracts are over a very broad exposure of a grey quartz-granophyre, the rocks generally being very uniform in character, but at the cataracts they are traversed by some narrow veins of black, very compact basalt. A few narrow veins of quartz, and, as is rather a common occurrence in the porphyrites, some scattered cubes of pyrite occur in the granophyre.

At Tiboku Cataracts the river bends rather abruptly to the west, and at their head almost suddenly to the northward.

Above the main cataracts at Tiboku, in the upper rapids on the left bank for about a quarter of a mile, immense blocks of diabase and of concretionary ironstone occur, whilst for about a similar distance the bank above consists of large, smooth, rounded exposures of diabase of from medium to coarse texture. Near the mouth of the Karamang Creek, above the cataracts on the right bank, and again on both banks of the river, diabase is seen for about one hundred yards, while higher up three dykes of diabase are traceable across the river, the rocks on the right bank being alternations of quartz-porphyrite and of diabase.

On the hill on the left bank of the Tiboku Cataracts, for about fifty feet above the level of the river, the rocks consist of quartz-porphyrite and of feldspar-porphyrite, generally of a dark-grey tinge, but speckled with yellowish patches near their junction with diabase. From about fifty feet to the summit of the hill, which is about three hundred feet above the level of the river, the rock consists of coarse-textured diabase, masses of which, in some cases from thirty to forty feet high, are scattered through the dense forest.

For some distance above Tiboku Cataracts the rocks in the channel and on the banks of the river consist of quartz-porphyrite and of feldspar-porphyrite, but at about six miles above Tiboku, near the left bank of the river close to the mouth of a small creek, is a large exposure of a fine-grained diorite, intersected by an intrusive vein of compact hornblende-porphyrite.

The general structure of the district from above Tamanua channel to the turn from the west, about six miles above Tiboku Cataracts, is that the course of the river and the low-lying country which extends for some distance from its bank, consists of gneiss and of porphyrites intersected by occasional dykes of diabase. At a little distance back from the banks of the river on both sides of it are low ranges of rounded hills, their contours being those usual among the diabase-bosses so common in many parts of the interior of the colony. The ridge extending along the left bank of the river stretches southward for about seven miles, deflecting the river from its general course of west and east to a north and south one curving round the range and cutting through it at a little above the Tiboku Cataracts, where broad dykes of diabase cross the river channel. The general structure of this part of the Mazaruni River valley resembles that of the Potaro-Konawaruk goldfields, especially of the upper parts of the valleys of the Mahdia and Minnehaha.

Above the exposures of diorite the country traversed for about eleven miles is quartz-porphyrite and porphyrite. About two miles above the diorite the river is crossed by a dyke of diabase, and about two miles and a half higher quartz is exposed in the river, samples of which yielded upon assay gold at the rate of seven grains per ton of the rock. In the neighbourhood of these exposures of quartz are several exposures of more or less schistose porphyrites, in places containing much calcite.

At about ten miles from Tiboku a dyke of diabase, having about sixty feet in width exposed, strikes north 20° east and south 20° west across the river, while about one and a quarter miles higher another of similar apparent width trends in the same direction. About four miles higher up the river a belt of hornblende-schist about two hundred yards across occurs, the strike of its foliation being approximately east and west. In this portion of the course of the river the land is generally low-lying but with occasional low hills, as near Warima Creek in the neighbourhood of the hornblende-schist.

Above the exposures of hornblende-schist the river's course is very tortuous, the general direction being from the north-north-west—the country for a distance, as the crow flies, of about nineteen miles being granitic—whilst the frequent changes in direction result in the actual course of the river being above thirty miles. The first rocks seen are about a mile to the north-west of the hornblende-schist, and consist of quartz-diorite, while above are many exposures of granitite, whilst the banks of the river show granitic decomposition-products. About four miles south-west of the exposures of quartz-diorite the Merumé River joins the Mazaruni on its right bank, the Merumé being about one hundred yards wide at its mouth.

Above the junction of the Merumé the course of the Mazaruni is from the north-west by north for about eight miles, then curves to the south-east for some two miles to the Kurekur Creek, from whence is a fine view of the Sororieng Peak, thence it flows from the north-north-west for three miles, and westward for a mile and half to near the mouth of the Mahwaiparu Creek, the land being generally very low and swampy. East of the Mahwaiparu Creek, at the foot of a low hill, an exposure of fine-grained diabase occurs. Above this place the river flows through low-lying land, and fine views of the Kamukusa and Merumé Mountains are seen, the ranges being probably from ten to fifteen miles off from the right bank, while in the far distance the Ayangkanna Mountains, a sandstone range with characteristic precipitous sides and square tops, are visible. About half a mile above a large forest-covered island near the northern end of the curve, a broad dyke, about eighty yards wide, of diabase, trending north-east and south-west, crosses the river. The rock of which the dyke is composed is coarse in texture and light-grey in colour. The river above this dyke flows from the westward, its course curving at first somewhat to the north and later towards the south, and from this reach fine views are obtained of the castellated peak of the Tomasing Mountain, in elevation probably about three thousand feet. The granitite terminates about halfway up this reach near the Tomasing Creek mouth, where exposures of fine-grained diabase occur on the left bank. West of here the river flows round a great, almost circular, curve for a distance of seven miles, and along the curve exposures of quartz-porphyrite and of felsite, more or less schistose in character, are frequent, while at the end of the curve a mass of very coarse-grained feldspathic diabase is seen.

From here to San-San-Kopai landing, a distance of about fifteen miles, the rocks seen are quartz-porphyrite and felsite, intersected in several places by dykes of diabase. The first is situated at about a mile above Aping Creek, where a dyke about twenty feet across of a dark-coloured, almost black, diabase of rather coarse texture strikes north 15° east and south 15° west; a second of a fine-grained variety at Towabaru Creek strikes south 80° east and north, 80° west, and is about forty feet in width; while about half a mile higher a third trends in the same direction, and is about the same thickness. At Kuribenang Island and Creek a large boss of medium to coarse-textured diabase is exposed in places for about three hundred yards. At about three miles below the San-San-Kopai landing, the Karabung, a large river about one hundred yards in breadth at its mouth, which has its sources in the sandstone mountains on the right bank, flows into the Mazaruni.

From San-San-Kopai landing to the landing at the mouth of the Isenaru Creek, belonging to the Barnard Syndicate, the distance in a straight line is about nineteen miles, the general direction of the river being from the north-west. For about thirteen miles the course is through quartz-porphyrite and porphyrites frequently more or less schistose in character. Above this the river follows a very winding course from Isenaru Creek, and the rocks are hornblende-granitite and quartz-diorite, while at the mouth of the creek a mass of coarse-textured epidiorite is exposed.

Above the junction of the Isenaru Creek with the Mazaruni River the river flows through the lower shales of the sandstone formation, and it enters on the sandstone proper at Peimah Fall.

About three miles up the Isenaru Creek, and for about a mile from its right bank, the path leading to the Barnard Placers on the Harimaraka Creek traverses shales and mudstones of the sandstone formation. These are very similar in character to those seen in the Cuyuni River and at Amatuk Falls in the Potaro River. Further along the path are exposures of coarse-grained granitite, while at the placers is a hill of mica-gabbro.

The Puruni River.—The Puruni River flows into the Mazaruni River on its left bank at a distance of about sixty-seven geographical miles from Bartica. Compared with the latter it is a narrow river, being about eighty yards across opposite to the Government Officers' Station about a mile and a half from its mouth. The river pursues a somewhat tortuous course from its mouth to the Mara-Mara Creek, the general direction of its flow being from the north-north-west.

The junction of the Puruni with the Mazaruni takes place at the abrupt turn of the latter from the west near the Kurabiri Rapids. When the water in the Puruni is low its junction with the Mazaruni takes place over a ridge of rocks running east and west across its mouth, which gives rise to low cataracts or to small rapids according to the height of the water. The ridge consists of gneiss having tongues of diabase, changed to proterobase and to epidiorite, intrusive through it. Many exposures of gneiss—generally rather fine in texture, and in places weathered into great slabs—are seen along its course from its mouth to above the station. A little below the station the river is crossed by a dyke of diabase, apparently about twenty-five feet in width, trending to the north-north-east and south-south-west. This dyke has sent off-sets and narrow tongues into the neighbouring gneiss, as may be seen in the rock exposed at the Government Officers' landing.

Between the Puruari River, which flows into the Puruni River on its left bank about a mile above the station, and the mouth of the Puruni is a hill, about 500 feet high, consisting of medium to fine-textured diabase, which is in parts covered with great masses of concretionary ironstone. Near the Puruari River the diabase overlies a banded coarse-textured hornblende-granitite-gneiss. Between the station and Taparau landing, about 5 miles in a straight line to the north-west of the former place, many exposures of granitite-gneiss occur with, in places, the rock weathered into great slabs. As a rule, the foliation of the gneiss is well-marked, the general trend of the lamination being south-west and north-east, but in places being in the directions of either west-north-west and east-south-east or of east-north-east and west-south-west. At Taparau Island and landing the rocks exposed are medium to fine-grained granitite-gneiss, with layers of hornblende-granitite of fairly coarse texture. Between Taparau and Thomas Cataracts the rocks are granitite-gneiss and hornblende-granitite-gneiss of varying texture. A little below Thomas Cataract, on the left bank of the river, a bank about 30 feet in height of red clay is seen, probably a decomposition-product either from diabase or from some other basic rock, followed by exposures of concretionary ironstone.

Thomas Cataract is caused by a belt of somewhat gneissose pinkish hornblende-granitite which extends for some 600 yards above the cataract. For about a mile above the belt of granitite near Thomas Cataract gneiss is exposed, and it is followed by a narrow band of granitite, probably about a quarter of a mile across, through which a dyke of diabase trends north 20° west and south 20° east, its breadth being from 12 to 15 feet. From above this belt of granitite to the foot of the Great Falls the rocks are gneiss, and in places the closeness of the foliation causes them to resemble crystalline schists. The small cataract called Great Falls is caused by a belt of reddish gneissose hornblende-granitite, about a mile in width, which extends from its foot to above the foot of the itabo near the head of Long Falls. Above the granitite is a long series of exposures of epidiorite, of amphibolite, and of hornblende-schist. The first exposures are of an epidiorite, which originally contained large phenocrysts of augite, now altered to hornblende, and are succeeded by some of a more or less schistose amphibolite, which near the mouth of Tiger Creek and for some 250 yards above, shows the structure of horneblende-schist, the strike of its foliation being about north 20° west and south 20° east.

About 300 yards to the north of Tiger Creek the hornblende-schist is traversed by a narrow belt of very fine-grained biotite-schist. At the foot of the Stop Falls Rapids the rock is an epidiorite, while the middle and upper parts of the rapids are over fine-grained actinolite-schist, extending for about three-quarters of a mile along the course of the river above Stop Falls. Here the river traverses a belt of hornblende-granitite-gneiss for about a quarter of a mile, while thence to Williams and Essex landing the rocks are of finer grain than those below Stop Falls, and, as a rule, consist of feldspathic hornblende-schist, with, in places, belts and masses of coarser-grained more basic amphibolite. From Williams and Essex landing to Burgomaster landing the rocks seen are hornblende-schist and amphibolite.

The belt of epidiorite, amphibolite and hornblende-schist traversed by the river has a breadth of at least 4 miles from east to west and a length of about 7 miles from north to south, but its area is probably far greater. Through the belt, in addition to the unaltered rocks seen, concretionary ironstone in large boulders, and in places forming rock-masses of considerable extent, is of frequent occurrence, while near the mouths of small creeks flowing into the river banks of pebbles of ironstone and of hornblende-schist are frequent, some of the banks being of considerable extent.

From below Burgomaster landing to about half a mile from Thornhill's Landing, the exposures consist of ferruginous schists and hornblende-porphyrite, in which, about half a mile below the latter landing, near the left bank of the river, are large masses of glassy quartz traversed by very numerous rusty-looking films. The samples of the quartz collected assayed at the rate of thirty-seven grains of gold to the ton of rock.

Above Thornhill's Landing are exposures of hornblende-porphyrite, but as a rule in this neighbourhood the rocks seen are too much altered and decomposed for determination. About a mile and a half above Thornhill's Landing there are some great masses of quartz on the left bank, very similar in character to that below the landing, the samples from which yielded gold at the rate of fifteen grains per ton of the rock. Between these masses of quartz and Barnard's Landing only ironstone and ferruginous gravels are exposed. In the course of the river above Barnard's Landing are several exposures of rock consisting of more or less schistose quartz-porphyrite. Near and above the mouth of the Mara-Mara Creek large masses of quartz-porphyrite are seen which contain, in places, many cubes of pyrite.

The path leading into the forest behind Thornhill's Landing passes for some miles over gravels largely made up of concretionary ironstone pebbles, and in places over masses of ironstone-conglomerate, the only unaltered rock exposed being an amphibolite.

CHAPTER XVI.

THE ESSEQUIBO RIVER.

From Bartica for a distance of about five miles up the Essequibo River there are few exposures of rocks, the land, at all events near to the banks of the river, mainly consisting of alluvial deposits. A small exposure of gneiss is seen about two miles from the town. At about five miles from Bartica there are several exposures of rocks, all being grey granitite, and at about half a mile south of Monkey Jump Point a coarse diabase is exposed at intervals for about one hundred and fifty feet, large masses of it being seen on the left bank of the river. At Monkey Jump the river cuts through a broad dyke of very coarse diabase, which is exposed for nearly two hundred yards on both banks of the river. A little south of Monkey Jump grey granitite is exposed at intervals for about five miles, varying a good deal in its texture from moderately fine to very coarse. A dyke of diabase of medium texture trends north 60° east and south 60° west about one mile and a half north of Kumaka Serima through the granitite. The rocks exposed at Kumaka Serima consist of fine-grained grey granitite, through which a dyke of coarse-grained diabase, about sixty feet across, cuts in a direction parallel to the one north of this place. At Bethany Island the granitite is coarser in texture than it is at Kumaka Serima. Near the foot of the Aretaka Rapids gneiss is seen with great boulders of granitite lying upon its surface. From Aretaka to Abuya Marali the rapids and cataracts are over gneiss which varies greatly in texture, and is intersected by many veins of coarse-textured pegmatite and of fine-grained granitite. South of Abuya Marali granitite is the prevalent rock to above Moneri Island at the head of the Aharu Rapids, where it again gives place to gneiss.

At Abuya Marali the granitite is crossed by a narrow dyke, about eight feet in breadth, of a fine-grained compact diabase running in a north-easterly direction. The weathering of this dyke differs from that usually characterising diabase, and instead of standing out from the other rocks in great masses it has been largely removed by denudation, and a shallow trough marks the line of the dyke. At Abuya Marali and at Itaballi the granitite has caught up blocks of dark-coloured gneiss with highly contorted foliation, and is traversed by pegmatite veins containing large crystals of feldspar, and patches of quartz with plates of biotite not unfrequently from one to one and half inches in length. Near the head of Itaballi Rapids the granitite is traversed by a narrow dyke of dark-grey diabase running north-west and south-east. From here to above Aharu Rapids the rocks are granitite of a grey tinge; and above Aharu a coarse-grained variety, capped by a fine-grained one, is noticeable, the latter closely resembling that at Bethany Island and Kumaka Serima. The difference in their modes of weathering is very marked, the former producing great rounded masses, the latter angular boulders. Near Moneri Island the coarse granite is traversed by frequent veins of pegmatite, and by one of a hornblende-granitite or quartz-diorite.

The rock exposed at Rockstone is a granitite-gneiss with faintly marked foliation. Similar rocks are exposed in the channel near Gluck Island when the water is very low. At about one and a half miles south of Rockstone a remarkable ridge of rocks running north and south for a distance of one hundred and fifty yards occurs in the eastern channel. The rocks are quartzite, made up of rounded pebbles and grains of clear quartz cemented together by secondary quartz, which shows as minute distinct crystals in small hollows in the rock. The quartzite did not yield to assay any trace of gold. Possibly this rock is an outlier of the great sandstone formation, or else is an altered portion of a still earlier sedimentary deposit. From this place to Arriwini Island, at the east of the south end of Gluck Island, no rocks are seen but the decomposition-products exposed on the banks of Gluck Island, and on those of the mainland are all of a granitic or gneissose nature.

Arriwini Island consists of diabase, apparently an intrusive boss having its long diameter lying north and south. South of the end of Gluck Island, on the western bank of the river, gneissose rocks are exposed in places through the sandbanks. On the same bank to the south of Tikuru Inlet are large exposures of fine-grained, light-grey gneiss with highly contorted foliation, containing many basic inclusions of hornblende-schist, their dark glistening surfaces showing strongly in the surrounding lighter rock. The gneiss is traversed by elvans of aplite and of pegmatite, and by thin veins of quartz. The general strike of the foliation of the gneiss is south-east and north-west.

No rocks are visible between Tikuru and Moco-Moco Point, a distance of about nine miles, and the decomposition-products noticed on the banks of the river are all of granitic origin, their structure in many places showing them to have been derived from gneissose rocks. This stretch of river contains many large sandbanks, which hide any rocks which otherwise might be exposed near the frequently occurring islands.

About three-quarters of a mile north of Moco-Moco Creek, on the west bank, two parallel dykes of diabase strike north-east across the river through hornblende-granitite-gneiss, the more northerly one being about twenty feet across, the other about seventy, and both send off narrow tongues through the gneiss. The larger dyke is of coarse texture, with a well-defined chilled edge of very fine texture. The smaller dyke is fine-grained, while the narrow tongues are very compact and closely grained. The gneiss is traversed by many thin veins of quartz, and by broader elvans of aplite. It is noticeable that the gneiss, where in contact with the diabase intrusion, loses its foliated structure, and, in hand-specimens, strongly resembles a massive granite.

Hornblende-granitite-gneiss is very frequently exposed in great rounded masses for a distance of more than three miles from Moco-Moco to Yukurisi Island, and about a mile south of Moco-Moco Creek is traversed by a dyke of diabase striking north-east and south-west. About half a mile south of Yukurisi Island a belt of coarse hornblende-granitite commences, and extends to near the south end of Dehalibanna Island. The granite is seen weathered into sub-angular blocks on the east of the river near Ararapira Point, and on the mainland, at the point, it contains porphyritic crystals of feldspar, frequently from one and a half to two inches in length. It also contains some caught-up pieces of hornblende-gneiss. To the south of Ararapira Point a dyke of diabase, about twenty feet wide, strikes through the granite east-south-east across the river, giving rise to the Ararapira Rapids. The junction of the diabase and granite is well seen. A hundred yards south two narrower dykes occur running parallel to the Ararapira Dyke. About a quarter of a mile north of Dehalibanna Island, granitite-gneiss occurs, and forms the prevalent rock for fifteen miles until approaching the Omai Mountains. At the south end of Dehalibanna Island a dyke, about fifty feet wide, of a porphyritic epidiorite, with crystals of labradorite up to two inches in length, strikes south-east and north-west through a sandbank.

At the north of Arasaru Point masses of gneiss are exposed in the river, giving rise to small rapids. Near Arasaru Creek the gneiss is traversed by an elvan of aplite. At Arasaru southern point three dykes of diabase occur, two narrow ones to the north of the point, each about eight or ten feet across, sending thin tongues into the gneiss, and one to the south of the point, approximately parallel to the others, which curves in its trend across the river from north-north-east to south-west. The latter varies in width from forty to sixty feet, and is capped, in places, with concretionary ironstone. About one hundred yards from the south-west end of the dyke a vein of non-auriferous quartz, about five feet wide, runs through the gneiss in a north-easterly direction. About half a mile south of this dyke, at the southern end of Kwapana Island, a diabase dyke passes through the island in a north-easterly direction. It is visible again a little further south in the river, near the west bank, trending to the south-south-west. In this dyke, which is exposed for about a mile, the two directions of the main joints are respectively parallel and at right angles to its trend. Half a mile south of the south-west exposure of this the river is crossed from north-east to south-west by a diabase dyke about twenty feet in width, while between two and three hundred yards south of the latter another trends north-north-east and south-south-west.

At Akenna North Point a broad expanse of gneiss is exposed on the east bank of the river, with many narrow dykes and veins of diabase traversing it in a north-easterly direction; and a little south of the Point the gneiss is crossed by two parallel dykes of diabase, one of which is fifteen, the other eight feet in width, which trend from east to west. A third dyke crosses the river in a north-easterly direction, somewhat further south, and in part consists of a greenish-coloured porphyritic epidiorite or proterobase. At about a quarter of a mile below this a dyke of diabase crosses the river, trending north-east and south-west.

The numerous dykes of diabase, in places changed to proterobase or to epidiorite, which traverse both the granite and gneiss from Ararapira to Akenna, a distance of about nine miles, all trend towards and are offsets from the great mass of diabase which gives rise to the range of hills reaching from Arasaru Hill, where it attains a height of seven hundred and twenty feet, on the Essequibo, in a north-easterly direction to Tiger Hill, and to the east of the Demerara River at Malali. This great mass has evidently been thrust through a fissure or series of fissures in the granite and the gneiss, which it overlies on the banks of the Essequibo and of the Demerara Rivers, and has poured over them, affording a good instance of the fissure-eruptions by which the diabase, which forms an important part of the rocks of British Guiana, was intruded through, over, and between the other older formations.

At Kura Kura point the gneiss is traversed by a dyke of diabase, varying from forty to sixty feet in width, which trends towards the north-north-west. Opposite to the Kumaparu path to the Demerara River a diabase dyke near the east bank of the Essequibo River strikes south-south-east and north-north-west, while about a mile south-west another trends east and west, at a place known as Kumbaru Point. Here the somewhat coarse rock of the main dyke is traversed by a later intrusion of very fine-grained basaltic diabase.

At Kumbaru the river changes from the south and north direction, which it pursues from here to its mouth, to a west and east one for about twelve miles, the middle and the north-west parts of its course being very shallow, and covered in many places with extensive sand-banks, and, beyond the turn, with rough masses of concretionary ironstone conglomerate. This conglomerate commonly occurs in the rivers of the colony where there are shallows near to extensive exposures of diabase or of other basic rocks.

For some distance before arriving at the German Syndicate's landing at Omai, about three and a half miles west of Kumbaru Point, the only rocks seen are concretionary ironstone and diabase, the latter being largely exposed at the landing, where it is very coarse-grained, tending in texture to a gabbro, but retaining its characteristic ophitic structure. The hills in the neighbourhood are composed either of diabase or of its degradation-products—ironstone and laterite. The bottoms of the valleys in places, and the mining drifts and shafts near Gilt Creek, penetrate into the underlying granitic and schistose rocks. The road from the landing to the placer and mining claims on Gilt Creek passes over the brows of hills covered with ironstone conglomerate. On the path from the works to the falls on the Omai Creek are exposures of porphyrite, of epidiorite, and of greatly altered diabase containing much carbonate of calcium and magnesium. Great masses of diabase of medium texture are exposed at the Omai Falls.

For from one and a half to two miles from the landing at Omai diabase is frequently exposed in the river, and especially on its northern bank, the general trend of the exposures being east-south-east and west-north-west. On the southern bank of the river, about half a mile west of the landing, a quartz-porphyrite of somewhat schistose structure occurs, and is seen at intervals for about two miles. Here and there it is traversed by dykes of fine-grained diabase. Near the middle of the river, commencing at about a mile from Kumaka Landing and extending for about three-quarters of a mile, there are many rocks and small islets, the general trend of which is east and west. The rocks consist of epidiorite and of hornblende-schist.

At Kumaka Landing a belt of coarse granitite traverses the river, producing a series of islands, while the channels between them being frequently interrupted by great masses and boulders of the rock, give rise to the Kumaka Rapids. The islands extend for about three miles. The great masses and boulders of granitite are usually much affected by weathering, and in places where the rock is of a massive structure the surfaces exfoliate in concentric layers, giving rise to rounded masses; while in others, where the rock exhibits, in common with the granitic belts of the district, a somewhat gneissose structure, the outer portions split off in flat plates, producing angular blocks. From the surfaces of the weathered rocks narrow veins of quartz, usually not more than two inches across, stand out in relief. Near the head of the Kumaka Rapids, two approximately parallel narrow dykes of diabase are visible on the north bank of the river, crossing it from north-north-east to south-south-west. Above the rapids the granitic rocks extend to Krabbu Falls, where they are traversed by a great dyke of diabase from eighty to one hundred feet in width, trending from the northern bank towards the middle of the river to the south-south-west, and from there to the southern bank to the south; near the east end of Smith's Post Island the dyke divides, sending off an off-set to the south-west. The off-set cuts into an aplite of which the mass of Smith's Post Island is composed, and exposures of which are seen near its north-east point.

The south-east end of the island is traversed by a dyke of diabase, more or less altered to epidiorite. From the south-west end of Smith's Post Island the river gradually changes its direction and flows from the south-south-west and later from the south. Many low rocky islets, with a general trend of east and west, are exposed for about a mile or a mile and a half to the south-west of Smith's Post Island, and are composed of epidiorite, while a large mass of the same rock occurs on the south-east bank of the Essequibo about half a mile from the end of the island.

At the mouth of the Potaro River the Essequibo is crossed from east to west by rocks having a marked schistose structure, and weathering into great slabs. Those exposed on the east bank are much altered by weathering and are practically quartz-schist, while those in the middle of the river, at the east and west ends of the island in the mouth of the Potaro and on the south bank of the latter river, near its mouth, are sericite-schists derived from quartz-porphyrite. The schist can be traced to the quartz-porphyrite from which it has been derived and which is seen in places almost unaltered. A highly metamorphosed rock occurs on the west bank of the Essequibo, south of the Potaro mouth, in the form of a fine-grained chloritoid rock with a greasy feel somewhat resembling that of serpentine. In this schistosity has been developed, but not the same extent as in the rocks derived from quartz-porphyrite.

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PLATE 17.

DIABASE ROCKS,

WITH "TIMEHRI" WRITINGS, AT

WARAPUTA CATARACT, ESSEQUIBO RIVER.

Photo by H. I. Perkins.

On the west bank of the Essequibo River, about one and a half miles from the mouth of the Potaro and north of Yesi Island, are large exposures of quartz-porphyrite, whilst similar ones occur on the east bank opposite to the island. Rounded masses of fine-grained gneiss, much altered by weathering, occur on the east bank of the river near the south of Yesi Island, and are traversed by a dyke of compact, dark-grey quartz-porphyrite which weathers into angular blocks. The dyke gives rise to small rapids in the eastern channel of the river. South of Yesi Island the rocks have a more or less marked schistose structure, and are derived from porphyrites, felsites, and quartz-porphyrites.

About a mile north of the mouth of the Konawaruk Creek a narrow dyke of diabase crosses the river from east to west, and half a mile south of this another one trends north-east by east and south-west by west. Exposures of quartz-porphyrite occur towards the east bank of the river south of the latter dyke. North of the mouth of the Konawaruk Creek a broad dyke of diabase of medium texture crosses the river striking south-west by west and north-east by east, giving rise to the Lower Konawaruk Rapids. South of the Konawaruk three dykes of similar rock to that of the one to the north and parallel to it in trend are the causes of the upper rapids. About half a mile south from here, in the middle of the west channel of the river near the north end of Benhori-Bumoco Island, there is a pointed mass of a fine-grained, somewhat schistose, quartz-porphyrite; and about a mile and a quarter south-east of this the river is crossed by a narrow dyke of epidiorite striking north-east through the island towards the east bank of the river, while at and near the south-east end of the island the rocks consist of greyish fine-grained quartz-porphyrite. Somewhat north-east of these, on the east bank of the river, is an exposure of a very dark-grey, compact quartz-porphyrite weathering like granite, and becoming somewhat schistose near the island where it gives rise to small rapids. The quartz-porphyrite is traversed by thin veins of quartz, a somewhat unusual feature in this class of rocks in this district.

About a mile south-east of the southern end of Benhori-Bumoco Island the river is crossed from east to west by a dyke of coarse-textured diabase, followed at about fifty yards by a narrower one parallel to it. South of these diabase dykes there is an exposure of gneiss on the east bank of the river. Two miles south-east of Benhori-Bumoco Island the course of the river is interrupted for about a mile by the Waraputa Rapids and Cataracts. The river, which runs from these rapids to the mouth of the Konawaruk in a north-westerly direction, for a long distance south of Waraputa pursues a northerly course. The western rapids are caused by confused masses of coarse, more or less gneissose hornblende-granitite, the east or main fall being over the same rock, through which a dyke of light-coloured diabase (altered in places by contact to epidiorite) passes with an east and west trend at the foot of the fall. The intrusive rock is covered in places with rude prehistoric figures of the kind known in the colony as Timehri writings. About two hundred yards north of the fall a very dense, almost flint-like, compact, fine-grained quartz-porphyrite traverses the granite, and possibly supplied the carvers of the figures with the material for their implements.

The granite extends without interruption for nearly one and a half miles south of Waraputa, and is then traversed by two dykes of fine-grained diabase about a quarter of a mile apart, both trending north-east and south-west. To somewhat south of the remarkable granitic rock known as Paiwori-Cayra the river runs through masses of coarse-grained granite, which, in places, has a somewhat gneissose structure. When the river is low the interruptions caused by these masses of granite in the channels between the islands, with which the river is here dotted, give rise to numerous small rapids. Paiwori-Cayra consists of an immense mass of coarse granitite resting upon a smaller one of the same rock, and forms a striking figure in the scenery of the river.

Somewhat over a mile south of Paiwori-Cayra the series of rapids and cataracts known as the Haiowa Falls commences, and continues at short intervals for nearly six miles. About a quarter of a mile north of the lowest rapids of this series an exposure of hornblende-schist occurs on the west bank of the channel. The lowest rapid is caused by a dyke of diabase traversing the river from north-west to south-east. Nearly a mile south of this, near the magazine of Greathead and Bascom's Placers in the channel leading to the main falls, is an exposure of pyroxene-gneiss, with a vein of quartz containing porphyritic crystals of hornblende traversing it. For about five miles from this place the channel of the river is much interrupted by many masses of gneiss, producing frequent rapids and several low cataracts. The gneiss is, in places, traversed by tongues of granitite, aplite and micro-granite. For about a mile and a half above the top rapids of the Haiowa series the river flows quietly between numerous small islands, and its course is uninterrupted until it is traversed by the great dyke of coarse-grained diabase which, trending north-east and south-west, gives rise to the Twasinki Falls.

South of Twasinki gneiss is the prevalent rock for between six and seven miles. The gneiss varies from a coarse to a fine-grained texture, and at about half a mile south of Twasinki is traversed by a dyke of diabase parallel in direction to the great one at the falls. At the Lower Yucuribi Rapids the gneiss is interrupted by a mass of fine-grained granitite. Half a mile south of the granitite intrusion Great Yucuribi Fall is caused by a dyke of diabase cutting through the gneiss. Near the contact of the gneiss and the basic rock the former has apparently granitic structure, this alteration being similar to those noticed under like conditions elsewhere in the colony. A mile south of Great Yucuribi, Batewa Rapids are caused by a broad elvan of granophyre. Half a mile from Batewa Rapids a belt of rocks, consisting of coarse-textured amphibolite, is exposed at intervals in the river, while south of this Akaiwanna and Great Itanime Rapids are caused by a broad mass of diabase of medium texture, which on the west side of the river is succeeded by very coarse-textured diabase for a distance of over a mile. The weathering of the diabase above Great Itanime is in marked contrast with that of the diabase at and below the cataracts, the former

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Plate 18.

BELT OF GRANITITE AT THE PAIWORI-CAYRA RAPIDS, ESSEQUIBO RIVER.

Photo by H. I. Perkins.

strongly resembling that of granite and gneiss, the latter being of the usual angular type. The belt of diabase crosses the river in a north-easterly direction from the Takwari Mountains on the west to the Akaiwanna range of hills on the east. On the east side of the river above the Akaiwanna Cataract coarse-grained sandstones occur dipping in a southerly direction.

Coarse-grained diabase is seen at intervals on the western side of the river to Itababo Island and rapids, the rocks comprising which are of very hard white sandstone or quartzite, and have evidently been greatly altered and indurated by the intrusion of the neighbouring masses of diabase. Somewhat to the north of Takwari Mountain a belt of granophyre, resembling that seen at Batewa Rapids, is exposed.

The long island in the river south-east of Takwari Mountain is composed of fine-grained sandstone of a red to chocolate colour, thinly bedded, and dipping at an angle of about 20° to the south-south-west. On the western shore of the island is the section represented by C. B. Brown in his sketch No. 4 on page 67 of the "Geological Reports." The sandstone, where nearest to the mountain, but still at a distance of at least a quarter of a mile from its base, changes from a chocolate to a dark-grey colour, and in one place the beds for a distance of some ten to twelve yards are altered to a very compact, black rock of somewhat coarse jasperose texture with a superinduced rectangular jointing, and having a striking resemblance to an intrusive igneous rock. Microscopical examination shows the rock to consist of fine-grained feldspathic grits highly metamorphosed by the neighbouring diabase mass. The red-coloured sandstone on the south of Itababo Island is traversed by a narrow dyke of diabase, an off-set from the mountain mass, and for a short distance from the edges of the dyke it is changed from a somewhat soft rock to a very hard quartzite of a glistening white appearance. As already mentioned, the sandstone on the east of the river extends further north than on the west, and is seen a little south of Akaiwanna Fall.

CHAPTER XVII.

THE POTARO AND KURIBRONG RIVERS.

The Potaro River.—The Potaro River, from its junction with the Essequibo to the mouth of its tributary, the Kuribrong, pursues a westerly and easterly course, and from the Kuribrong to the Kaieteur Fall a south-westerly and north-easterly one.

The sericite-schist rocks described as occurring in the Essequibo, near its junction with the Potaro, are also exposed in the latter river, near its mouth, on both banks, on the small island near its mouth, and at short intervals for about two miles up the river. On the southern bank, near the mouth, is an exposure where the sericite-schist is in contact with a chloritoid rock. The degree of schistosity in the sericitic rocks varies greatly; in places they are almost massive, while in others the schistosity is developed to a marked extent, and they resemble soft shales or slates. About three and a half miles from the mouth of the Potaro, near the entrance of its tributary, Tiger Creek, compact porphyrite takes the place of sericite-schist and is seen at intervals for about a mile along the course of the river on both banks, and in the river. About half a mile west of Tiger Creek there is an exposure of diabase on the southern bank. Near Bucktown, about a mile east of Tumatumari Cataracts, porphyrite is exposed, and below the foot of the cataracts there are large exposures of massive quartz-porphyry near the south-western bank, whilst others protrude through the sand of the extensive sandbanks on the north-eastern side of the river.

Tumatumari Cataracts are caused by a great dyke of diabase of very varying texture which crosses the river with a trend of east-north-east and west-south-west, the dyke being not less than five hundred yards across. The mass of the rock is coarse in texture, in places almost approaching a gabbro in structure, while its margins are compact and fine-grained. It is intersected by later dykes and tongues of diabase and of basaltic diabase, or tholeite, running, as a rule, east and west. One of these, a coarse diabase, to the south of the cataracts, is about twenty-five feet in thickness; another, near the middle of them, is about a foot across and traverses both the diabase and the quartz-porphyry at the foot of the cataracts; whilst between them is a third which consists of compact basaltic diabase, eight to ten inches across, having a columnar structure at right angles to its walls. These dykes evidently were injected into cracks in the main mass after its consolidation. The fine-grained diabase on the north-west of the head of the cataracts passes into a compact epidiorite, probably by contact action with the acidic rocks through which they were intruded. About

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PLATE 19.

UPPER PART OF TUMATUMARI CATARACTS

(IN RAINY SEASON),

POTARO RIVER.

Photo by C. W. Anderson.

half a mile west of Tumatumari are small rapids caused by a dyke of diabase running parallel to the main one at the falls, whilst diabase is exposed at intervals for about one mile west of the rapids.

About two miles west of the cataracts the river traverses a broad mass of fine-grained epidiorite, and exposures of similar rock occur at intervals for about six hundred yards, the general trend of the rocks being north-west and south-east. During the next two miles diabase is seen at intervals, apparently forming portions of dykes trending north-east and south-west. The low-lying banks between the mouth of the river and about six miles west of Tumatumari consist largely of alluvial and fluviatile deposits. About five miles west of Tumatumari the river crosses a belt of schistose quartz-porphyry, first seen on the south bank and later trending across the river in a northerly direction. Near D'Amil's Stream the quartz-porphyry is more massive and has a well-marked rectangular jointing; exposures of this rock occur for about three hundred yards, having a general trend of north and south. One mile west of these exposures, the end of a great dyke of diabase, of very coarse texture, juts into the river on its north bank, and is there some sixty yards across. Its strike is north-west and south-east, and it is succeeded by a fine-grained, greenish epidiorite. West of this, for about a quarter of a mile to Garraway's Landing, a belt of quartz-porphyry is visible, the rock being usually more or less schistose in character, but in places, as near the Konawak Creek Mouth, it is massive. At Garraway's Landing quartz-porphyry is traversed by a dyke of diabase of medium texture, trending north-north-east and south-south-west, and exposed on the west bank of the river for about six hundred yards, the river running parallel with the dyke. On the south-eastern side of the river near Garraway's Landing, when the water is low, the diabase may be clearly seen in contact with the schistose quartz-porphyry, the coarse diabase at the contact showing a chilled edge of fine-grained, very compact rock. About one hundred yards north-west of the landing the main mass of the diabase is intersected by a later flow of fine-textured diabase with a bedded appearance. Quartz-porphyry, both compact and schistose, occurs at intervals from the north-west end of this diabase exposure to about a mile north of Potaro Landing, and is traversed by a dyke of fine-grained diabase, trending east and west about a quarter of a mile east of the landing, whilst two others having a similar trend cut through quartz-porphyry west of that place.

Two miles north-west of Potaro Landing the Kuribrong River joins the Potaro, flowing from the north and north-east in its lower reaches, and from the north-west and west in its upper course. On the north bank of the Potaro, and on the east bank of the Kuribrong at its mouth, there is a great mass of quartz, whilst schistose quartz-porphyry is exposed on the west side of the latter river. At about a quarter of a mile south-west of the Kuribrong Mouth are some small islets and rocks in the river for about a quarter of a mile along its course, apparently trending north and south. These consist of reddish, dark-brown, and purple-coloured shales derived either from a felsitic mud or a feldspathic tuff. One mile south-west of the Kuribrong, near the site of the abandoned mission at Ichaura, are the Ichaura or Mission Rapids. These rapids are over compact quartz-porphyry, which is succeeded by feldspar-porphyrite about a quarter of a mile south of the main rapid; the latter rock is traversed by a broad reef of quartz running east and west; parts of this quartz-reef, which is slightly auriferous, have been worked for gold at a small stream known as Anderson's Creek, but without much success.

One mile south of the Ichaura Rapids the series of rapids and small cataracts known as the Cobanatuk Cataracts commences. Near the foot of Auritout Rapid, the lowest of the series, large quantities of concretionary ironstone coat the surfaces of quartz-porphyry rocks. Masses of quartz occur in the quartz-porphyry near this place. The Cobanatuk Cataracts extending from Auritout to Maurasema, the highest, are over compact quartz-porphyry traversed here and there by thin veins of quartz, and in places containing a little pyrites. Both at the Cobanatuk Cataracts and at Ichaura Rapids the sands lying below them on the sides of the river contain large quantities of titaniferous iron-ore, and yield an occasional colour of gold.

From Maurasema to near Pakatuk Cataracts, a distance of about one and a quarter miles by river, or about half a mile as the crow flies, the rocks are fine-grained, compact quartz-porphyry, this is traversed a little below the lowest Pakatuk Cataract by a dyke of epidiorite trending south-east and north-west, while a little west of this dyke a narrow one of similar rock trends east and west. Below the cataracts a fine-grained diabase occurs, forming some rocks in the river. Near the diabase-rocks the quartz-porphyry is of a schistose character, whilst the foot of the lowest of the four Pakatuk Cataracts on both sides of the river consists of compact, fine-grained quartz-porphyry. The Pakatuk Cataracts are over coarse granitite, a broad belt of which crosses the river for a distance of about two and a half miles. The granitite is a handsome grey, somewhat gneissose, variety containing pink porphyritic crystals of orthoclase and microcline, and with veins and patches of greenish epidote. In places the granitite contains small crystals of iron and copper pyrites. Near the second cataract from the foot, a narrow dyke of a porphyrite runs through the granitite, while a broad elvan of quartz-porphyry traverses the granitite, which is here very porphyritic, at the third cataract. Above the cataracts is a series of small rapids, where in places the quartz-porphyry is traversed by veins of granite.

A little more than two miles from the top of the cataracts the river crosses a narrow dyke of epidiorite, trending from north-east to south-west; and in the neighbourhood of Ekureparu Creek, about four miles south-west from the head of Pakatuk, the many rocks which are exposed on the banks and in the river consist of epidiorite. Near the mouth of the Ekureparu Creek the river flows for about three miles from the north-west, and about two hundred yards north of the mouth of the creek a dyke of diabase trends north east and south-west, while about one hundred yards further another

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PLATE 20.

PAKATUK FALLS (THIRD CATARACT),

OVER PORPHYRITIC GRANITITE,

POTARO RIVER.

Photo by H. I. Perkins.

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PLATE 21.

AMATUK FALL, OVER SANDSTONE,
POTARO RIVER.

Photo by H. I. Perkins.

one strikes across the river from east to west. Between these dykes and above them exposures of altered porphyrite occur, and at a distance of about a quarter of a mile from the creek a very fine-grained compact felsite is exposed, which has a red-chocolate colour, and much resembles the so-called "jasper" commonly found in placer-gravels. This is probably a quartz-porphyry altered by contact with diabase. It is traversed by a dyke of diabase trending north and south across the river, which has here a local direction of east and west. For a distance of about one and a half miles, to near Oewang Creek, quartz-porphyry and porphyrite, more or less altered, occur. Near Oewang Creek a broad belt of epidiorite is traversed by the river, and the rocks in it are covered with ironstone-conglomerate. Opposite Oewang Creek, and for about half a mile south of it, epidiorite is seen at intervals, the general trend of the rocks being north and south. For about a mile to tne south of this place more or less altered porphyrites occur, and about a quarter of a mile below Amatuk Falls, on the east bank of the river, a coarse quartz-granophyre underlies sandstones which dip to the south-west.

On the west bank, at a little distance below Amatuk Falls, there is a mass of diabase. On the same bank at the foot of the Amatuk Falls, when the river is low, a greenish rock is exposed, which is an altered porphyrite. This passes into a reddish-brown, more or less foliated rock, probably an indurated felsitic mud, or possibly a feldspathic tuff. Upon this, in places, masses of quartz are found, having a fluted structure repeated over many parallel layers. These flutings are casts of markings of a slickenside-nature impressed originally on the soft mud which here formed the base of the sandstone, and now preserved in secondary quartz. Amatuk Falls are over some of the lower beds of the great sandstone and conglomerate formation. Here the sandstone is fine-grained, with occasional quartz-pebbles, of a red colour, and shows very clearly, and in places markedly, current-bedding. Not more than about twenty-five feet of the lower beds are exposed in the actual section at the falls. A sill of diabase intrusive through the sandstone causes small rapids above the main fall.

For a little over a mile along the course of the river above Amatuk Falls the rocks exposed on the banks of the river are sandstone, and the cliffs and the mountains consisting of this. There is an exposure on the south-west bank of the river, and on a small island in it, of a very coarse-grained enstatite-diabase, intrusive through the sandstone. A little distance from here the river flows round the foot of a great mountain, which shows remarkable cliff-faces of sandstone forming vertical precipices over a thousand feet in height, the mountain itself being probably more than two thousand feet high. The river here passes over quartz-porphyry, which underlies the sandstone. Beyond this place coarse sandstone resembling quartzite is seen on its banks. About two miles from the exposure of quartz-porphyry a broad dyke of diabase crosses the river from north-east to south-west. giving rise to small rapids near Waracabra Island, which itself consists of this rock. The diabase is very coarse and granular, in structure approaching a gabbro.

From Waracabra to near Waratuk Rapids the only rocks seen are sandstone ; below Waratuk Rapids the river traverses for some distance quartz-porphyry, and the lower parts of the rapids are over this rock. The main rapids are over coarse diabase, which, in places, has an almost granitic structure. The variations in its structure are well seen on the portage-path round the rapids and at the upper landing. Two hundred yards above the rapids the river passes through quartz-porphyry.

About six hundred yards west of Waratuk coarse diabase is again seen, and about half a mile from the rapids a dyke of fine-grained diabase crosses the river from north-east to south-west. Half a mile south-west of this dyke the river is crossed by diabase of fine texture trending north-east and south-west. About a quarter of a mile further west diabase rocks of medium texture are exposed on the north-west bank of the river, near the mouth of a small creek ; while two hundred yards further a belt of coarse-grained diabase trending somewhat west of north occurs. The hills from near Waratuk to near this place in many instances resemble more diabase hills than sandstone ones. A little distance beyond the diabase rounded masses of porphyrite occur in the bed of the river and on its south-east bank. Diabase is also seen beyond these exposures on the northern bank of the river. Three-quarters of a mile from here a broad dyke, apparently about eighty yards across, of very coarse-textured diabase strikes north-east and south-west across the river ; and two hundred yards beyond it a belt of light-red indurated sandstone, altered to the hardness of quartzite, crosses the river, dipping at an angle of about 20° to the south-east, this dip being probably due to the elevation of the sandstone by the intrusion of diabase which has indurated and partially bleached it. For the next three-quarters of a mile only sandstone is seen, but at a little more than a quarter of a mile from Tukeit Landing a dyke of very coarse diabase traverses it. All the rocks at Tukeit, and above and below Tukeit Cataracts, are much indurated sandstone. The sandstone not unfrequently shows current-bedding.

The gorge of the river from Tukeit to the foot of the Kaieteur is through more or less indurated sandstone and conglomerate. The path from Tukeit Landing to the Kaieteur Plateau crosses the Orimetuk Creek at about a mile and a half from the landing. The creek affords a succession of excellent sections of the sandstone, which is, as a rule, red in colour and not much indurated. In the course of the creek, up its gorge at a level of about six hundred feet above the river, there is an interesting section clearly showing the relationship of the sandstone and diabase. Here a sill of coarse diabase, about eighty feet in thickness, cuts through the sandstone. Below the sill the sandstone has lost its red colour and is bleached ; in places it has been contorted by the intrusive rock, and for a depth of two or three feet it has assumed the physical characteristics of quartzite. At the contact the diabase of the sill is very compact and fine-grained, but this chilled edge is thin, and soon passes into the coarse-textured rock of which the mass of the diabase is composed. The upper part of the sill shows another chilled edge, and the sandstone above it is for some distance bleached and altered to a very hard

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PLATE 22.

SANDSTONE CLIFF,

RISING OVER 1,000 FEET ABOVE THE RIVER AT TUKEIT TOWARDS THE HEAD OF THE

KAIETEUR GORGE, POTARO RIVER.

Photo by H. I. Perkins.

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PLATE 23.

SANDSTONE MOUNTAIN,

OVER 1,000 FEET IN HEIGHT, NEAR THE ENTRANCE OF THE

KAIETEUR GORGE, POTARO RIVER.

Photo by H. I. Perkins.

quartzite. Mr. Dunn found more marked signs of the presence of gold in the sands of this creek just below the diabase than in any other place in the sandstone-formation which he examined during the Kaieteur Conglomerate Expedition. A dyke of diabase very similar to the rock of the Orimetuk sill traverses the conglomerate at the Waremure Creek on the Kaieteur Plateau, about one and a half miles from the fall, where the clastic rocks near it are much indurated.

The path from the Orimetuk Creek to the plateau passes over sandstone to near the top, and then over coarse conglomerate and pudding-stone.

The excellent account of the Kaieteur Fall and Plateau given by Brown in his "Report on the Kaieteur Waterfall" (p. 278, *et seq.*, of the "Geological Reports") requires no addition. His description is very complete and accurate.

Many of the mountains in the district explored by Messrs. Anderson and Dunn above the Kaieteur Conglomerate Plateau consist of coarse-textured diabase or gabbro, as, for instance, the Akobenang Mountain which rises to a height of 3,250 feet above the sea level. Thin sections of these rocks which I have examined show that some of the masses consist of unaltered intrusive diabase, whilst others are of more or less metamorphosed gabbro. The former are probably laccoliths in the sedimentary rocks, the latter mountain-masses on the flanks of which the sandstones and conglomerates were laid down.

The Kuribrong River.—The east bank of this river at its junction with the Potaro and for a distance of about seventy yards up consists of quartz, while near the west bank schistose quartz-porphyry, more or less altered, is visible. The quartz, which is quite free from gold, is a mass in the quartz-porphyry. About a quarter of a mile from the mouth quartz-porphyry and felsite occur which are much weathered. For the next half a mile or so the bed of the river, which is here broad and very shallow, is covered with quartz-sand; whilst very numerous large angular boulders of milky-white quartz and broad sand-banks interrupt its course. North of the belt of quartz-boulders the river crosses a dyke of epidiorite trending in a northerly direction. From here the channel of the river is fairly clear for about a quarter of a mile, and then is again interrupted by a second belt of sand-banks and quartz-boulders. One hundred yards above this sericite or quartz-porphyry schists are visible at intervals for about two hundred yards; whilst at about a mile and a half from the mouth of the Kuribrong River a dyke of diabase runs south-west and north-east, the rock being of medium texture. This is succeeded for about five hundred yards by broad exposures of sericite-schist crossed by a wide dyke, about eighty yards across, of diabase trending north-west and south-east. The outer parts of this dyke is a normal ophitic diabase of a fairly fine texture, weathering into angular blocks, but towards its middle the rock becomes coarser, approaching in structure to gabbro, and in the middle of the dyke, where the rock is granitic in its mode of weathering into great rounded masses, it passes into a very coarse-grained light-coloured quartz-diabase having a micro-pegmatitic structure. In this dyke the accumulations of the ferro-magnesian minerals and iron-ores to the edges of the dyke, and of the more acidic constituents to the middle of the rock mass, are very marked. Half a mile above the diabase dyke exposures of schistose quartz-porphyry and of sericite-schist occur, which are intersected by a narrow dyke of diabase. The schists continue at intervals for about six hundred yards, where three narrow dykes of diabase are intrusive through them, the dykes trending to the north-east. For about a mile further up the course of the river the rocks exposed are, as a rule, schistose-quartz-porphyry, with here and there quartz-boulders, only one exposure of diabase occurring. For the succeeding mile or mile and a half, up to the foot of the great series of the Kuribrong Cataracts, many exposures of diabase of varying texture occur, their general trend being north-east and south-west.

The Kuribrong Cataracts commence about four and a half miles from the mouth of the river, and extend along its course round a great loop for six or seven miles, the distance as the crow flies between the lowest and the uppermost fall being only a little over a mile. The river pursues a very tortuous course round the loop, traversing fine-grained gneiss, and during its passage through the narrow clefts in the rock it gives rise to eight small cataracts and to numerous rapids. None of the cataracts are of any great fall, but owing to the narrowness of the confined channel the water rushes over and through them with very great force. The gneiss is an epidote-granitite-gneiss at the foot of the cataracts, and is granitite-gneiss at the middle and top; it is traversed by numerous small elvans of felsite and quartz-porphyry, and here and there by thin veins and stringers of quartz, of which the thickest noticed, about eighteen inches across, is at the top of the series. The quartz of this vein contains only traces of gold.

Towards the middle of the series of cataracts the gneiss is traversed by two dykes of diabase, one being about five feet across with about one and a half inches of altered contact rock at its edges, whilst the other, situated a little lower down the river, where it gives rise to a cataract, is a great dyke fully fifty yards across; it is of fairly coarse texture towards its middle parts and is very compact near its junction with the gneiss. C. B. Brown describes, on p. 200 of the "Geological Reports," a curious triangular block at the end of one of the masses of rock in this dyke to which it is joined by a thin neck. This block occupies at present the same position as it did at the time of his visit, whilst lower down a similar block, weighing probably not less than half a ton, lies in the river, having fallen from the main mass, the narrow neck of which shows a clean, comparatively fresh fracture.

The chief features of the Kuribrong River in its reaches below these cataracts is the prevalence of schistose quartz-porphyries and sericite-schists, and of the boulders of quartz which in places obstruct its course. The district through which the river runs above the cataracts is mainly a granitic one until it reaches the sandstone-formation, and does not seem likely to be of value as a gold-producing one.

CHAPTER XVIII.

THE TIGER CREEK TRAIL AND THE POTARO-KONAWARUK ROAD.

The Tiger Creek Trail.—The path from Tumatumari to the Tiger Creek placers passes over two long ridges of diabase, off-sets from the mass which gives rise to the Tumatumari Cataracts, and when nearing Tiger Creek traverses low-lying land the only rock there seen being quartz-porphyry. After crossing the creek the path follows the course of the stream, in the bed of which are numerous boulders of diabase, to the lowest falls which are caused by the creek passing over a ridge of diabase in a series of leaps, the total drop being from thirty to forty feet. This ridge is part of the great dyke which, a few miles to the north-north-west, causes the cataracts at Tumatumari, and to the south gives rise to the Konawaruk Mountains. Diabase is the only rock seen for about a mile from here to where a small waterfall occurs. From above this waterfall to the head of the Top Falls, a distance of about two miles, the rocks consist of gneiss traversed here and there by narrow dykes of diabase. A good exposure of the gneiss is seen at the Top Falls. From these falls to the placers which belonged to the Garnett Syndicate the path leads over diabase-hills covered in places with concretionary ironstone-gravels. Here and there in the beds of the streams are exposures of quartz-porphyry and felsite. The ironstone-gravels are frequently auriferous. At the Garnett Syndicate placers a reef of granular auriferous quartz is exposed. Samples from this yielded to assay from two pennyweights to sixty-nine pennyweights of gold and from six to fourteen pennyweights of silver per ton of the rock.

From the Tiger Creek placers to those of Quintette on the Konawak Creek concretionary ironstone and diabase are the prevalent rocks, the latter occurring in great boulders on the surface, and in the gravels at the heads of the creeks. About two miles from the Tiger Creek placers the road crosses an exposure of a friable conglomerate of rounded quartz-pebbles which is apparently of recent origin.

The path from Quintette to Gloria Placer passes principally over concretionary ironstone and ironstone-gravels. At Gloria Placer, situated on a tributary of the Handrail Creek, which falls into the Mahdia Creek, a thin bed of a friable recent conglomerate of quartz-pebbles was found during the working of the placer, the gravel from which, upon assay, yielded gold at the rate of five pennyweights to the ton of the rock. A dyke of coarse diabase crosses the Gloria Creek between Gloria Placer and Quintette. The road from Gloria Placer passes over quartz-sand until it joins the Potaro Road about seven and a half miles from Potaro Landing.

The Potaro-Konawaruk Road.—The Potaro-Konawaruk Road starts at Potaro Landing from a hill of red clay, the degradation-product of diabase, and for some miles the hills traversed by the road, as a rule, show the same characteristics. In places the hills are covered with white siliceous sand, and in others with concretionary ironstone. Here and there, for instance at near the third and fifth miles, boulders of diabase of varying texture are found in the beds of little creeks crossed by the road. In the valleys, and on some of the hill sides, the road passes through or over white or light cream-coloured sandy clays clearly derived from granitic or felsitic rocks. The low hill on which is the road camp, near the eight mile post, is an example of this. A little beyond the road camp, at this place, the road passes through a cutting in red clay, containing ironstone-gravels and small boulders of diabase. Ironstone-gravels on the hill-sides, and red or ochreous clays, are the prevailing characteristics of the road from here until reaching the Inflexible Syndicate's Camp. On the roadside from the camp, descending the hill to the Mahdia Flats, where the placers of the syndicate are situated, there are some very large boulders of concretionary ironstone.

Near the Mahdiana workings of the Inflexible Syndicate, south-east of the camp, a compact felsite and a coarsely crystalline augite-granophyre, with narrow veins of quartz and with much iron pyrites, occur. Samples of the latter rock have yielded upon assaying at the rate of from two and one-eighth pennyweights of gold to the ton to as much as fifteen pennyweights. In the forest near the Mahdiana workings there are two very large boulders of conglomerate, or pudding-stone, resembling in character the conglomerate of the Kaieteur Plateau. These, probably, are remnants or outliers of the sandstone-formation which in former ages extended much farther in a north-easterly direction than it does at present.

The Mahdia is a large stream with a north-westerly and south-easterly course, flowing into the Potaro River above and at a distance of about three miles south-west of the Pakatuk Cataracts. The fluviatile deposits of sand and gravel along its course are everywhere auriferous to a greater or less degree. Unfortunately the flats on the lower parts of its course are very subject to flooding by the waters of the Potaro, and hence but little has been done in the way of working that part. The Mahdia Valley is filled by a fluviatile deposit of sandy clay of an ochreous colour, which is underlain by auriferous gravels. The bed-rock of the placers is a light-coloured or bluish-white sandy clay, evidently derived from the degradation of acidic rocks, probably of quartz-porphyry. In places the whitish clay is crossed by belts of sandy clay, which are deep ochreous to dark red in colour, and which doubtless represent former dykes of basic rocks.

Near Hope Placer, and again near the Hospital, rocks are exposed which consist of coarse-grained augite-granophyre or quartz-diabase infiltrated with carbonates, iron and copper pyrites, and galena. Specimens from near the Hospital were assayed, and were found to yield gold at the rate of thirty-three grains per ton. The hillsides near here are covered with ironstone-gravel, while the hills themselves are composed of diabase. In the placers of the Rhodius Syndicate, especially in those situated near the ravines on the hillsides, great boulders of diabase are of frequent occurrence. From thirteen to about fourteen and a half miles along the road many exposures of coarse diabase, which in places approaches the structure of gabbro, and of augite-granophyre are exposed, whilst from here to the fifteenth mile the rocks seen are more or less altered quartz-porphyrite and felsite. Jaspery felsite is present in abundance in the gravels at the Strong Hope Placer. About half-way between the fourteenth and fifteenth mile posts exposures of dark-brown and purple, compact, or in places schistose, rocks are exposed, which much resemble the rock seen on the Potaro River south-west of the mouth of the Kuribrong. From about the fifteenth mile post to the Divide, a distance of less than half a mile, the road-cuttings show diabase or its degradation-products, whilst at the Divide diabase lies over quartz-porphyry. Great boulders of diabase are of common occurrence in the placer-gravels in this neighbourhood, especially, as at Dispute, near the heads of the tributary creeks of the Mahdia.

The upper part of the valley of the Mahdia runs between two mountain ranges, the higher parts of which show bare precipitous cliffs standing out from the surrounding forest. The ranges appear to be mainly of similar structure. The Eagle Mountain Range on the east of the road is, up to an elevation of 1,300 feet, of diabase, immense masses of which are seen in the gullies and creeks. At about this elevation granitite-gneiss occurs, which has been carried up by the diabase, and is from two to three hundred feet in thickness. From near 1,500 feet to the crest of the range, a height of 2,150 feet above the valley of the Mahdia, the rocks, including those of the precipitous cliff-faces, are of coarse-textured diabase. The structure of the mountain indicates that during the protrusion of the masses of basic rock, of which the Eagle Mountain Range, and others which run parallel with it, consist, a portion of the granitic country, through which the diabase was thrust, was caught up in it.

A neck of diabase joins the eastern and western ranges of mountains at the Divide, and a very rocky path through abandoned placer workings leads into the valley of the Minnehaha, a tributary of the Konawaruk River, to which it flows in a south-easterly direction. The Minnehaha has many tributary creeks, on which are auriferous fluviatile deposits. The stream rapidly widens as it approaches the Konawaruk, where it traverses broad flats where auriferous gravels occur at considerable depths, which materially militate against the profitable exploitation of this part of the district.

The valley of the Minnehaha has been eroded through a district where quartz-porphyry, porphyrite, and similar rocks were intruded into and overlaid by great masses of diabase ; and the deposits in it represent the degradation-products of these rocks with some sandstone, quartz-sand, and pebbles derived from the sandstone formation which is found to the south and west of the district, and which, probably, once extended over it.

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PLATE 24.

PLACER WORKINGS,

MINNEHAHA CREEK AND EAGLE MOUNTAIN,

KONAWARUK DISTRICT.

Photo by C. W. Anderson.

CHAPTER XIX.

THE KONAWARUK RIVER.

The structure of the Konawaruk River is well seen whilst descending the river from the southern end of the valley of the Minnehaha to the Potaro River. Near the junction of the Minnehaha with a tributary of the Konawaruk, and at Two Mouth, where the latter joins the main river, the rocks exposed are dark-coloured porphyrites with dykes of epidiorite and of diabase. From Two Mouth to Jordan's Landing, a distance of about four miles, the river generally has an easterly direction, and but few exposures of rock are seen, the bed of the river being covered with sand and its course frequently interrupted by many fallen trees locally known as "tacoubas." The rocks exposed consist of granitite, varying somewhat in texture but generally coarse-grained, intersected in places by narrow dykes of fine-grained diabase, which near contact with the granitite is changed into compact epidiorite. The placers near Jordan's Landing are worked in angular quartz-gravel, here and there containing boulders of diabase and of epidiorite. The path from Jordan's Landing to the Potaro Road, which crosses over the Eagle Mountain range, runs over hills of diabase covered with concretionary ironstone and red clay—its degradation products.

From Jordan's Landing the river flows in a generally north-easterly direction through a valley, the bottom of which is filled with alluvial and fluviatile deposits, deep sections of these deposits being exposed in many places along its tortuous course, chiefly in its upper reaches. For about half a mile from Jordan's Landing, with the exception of local deposits of concretionary ironstone, grey granitite is the only rock seen. For the next mile the bed of the river is covered with sandbanks, no rocks being seen until a dyke of an augite-granophyre trending west-north-west and east-south-east crosses the river. Parallel to this, and apparently in contact with it, a broad belt of biotite-porphyrite, probably from four to five hundred feet across, is well seen on the south-west bank a little below an itabo through which boats have to pass when the river is low. A great mass juts out into the main stream, and consists of a porphyritic rock with crystals of greenish and of light-pink feldspar in a dark-grey groundmass, with here and there nests of chlorite, biotite and epidote. The rock is identical in character and appearance with one collected by Mr. Anderson from near Ironside Placer on the Minnehaha Creek.

Half a mile north-east of the exposure of biotite-porphyrite masses of granitite are visible in the bed of the river, intersected by a narrow dyke of fine-grained diabase, and changed locally where in contact with the granitite into epidiorite; these are succeeded about two hundred yards further down the river by a dyke of fine-grained diabase striking north-west and south-east. A quarter of a mile below this granitite is exposed intersected by a dyke of fine-grained diabase trending west-north-west and east-south-east; but the actual junction of the two rocks is not seen, as it has been deeply eroded into by the river. At Wilson's Landing coarse grey granitite is seen in the river followed by exposures of diabase of medium texture, which near the granitite is altered into proterobase. Wilson's and Caman's Landings are situated at the bases of hills of dark-red clay, the decomposition-product of diabase or of other basic rocks. Below the latter place diabase of medium grain trends south-south-west and north-north-east. In this neighbourhood, in many places near the banks of the river, ironstone-conglomerates are of very common occurrence.

Between Caman's Landing and the head of the itabu at Forty Islands, or Itabu Rapids, with the exceptions of a small exposure of quartz-schist, and of others of ironstone-conglomerate, the rocks are hidden by sand-banks. Above the head of the Forty Islands Itabu quartz-schist is exposed in the river for about two hundred yards. Through the itabu and the Forty Islands Rapids quartz-schist is exposed at intervals, but the bed of the stream is generally covered by ironstone-gravel. The quartz-schist, both from above the itabu and from among the islands, is not auriferous. At Forty Islands the river is split up into numerous small and narrow streams, in which the water flows with great velocity, producing a large number of small islets between which the streams are connected by narrow channels.

Half a mile north-east of the foot of Forty Islands the river makes an S-shaped curve, through which it pursues a tortuous course, the southern end of the curve, for about a quarter of a mile, being through hornblende-schist, exposures of which are visible at short intervals. Near Willis's Landing, at the northern end of the curve, masses of very coarse hornblende-granitite occur, followed at about one hundred and fifty yards down the river by a narrow belt of hornblende-schist trending east and west. The hornblende-schist is auriferous, and yields gold at the rate of two pennyweights per ton of the rock. The placers near here are worked in fluviatile sands and gravels deposited at some former period by the river. For half a mile north-east of Willis's Landing the rocks in the river are hidden by sand-banks, while for a similar distance to Stout Fall, exposures of coarse granitite occur at intervals.

At Stout Fall the rapids are over coarse granitite with narrow veins of fine-grained, dark-coloured quartz-porphyry. From here the river pursues a winding course to the north-east, the rocks seen being coarse gneiss and gneissose-granitite. These are crossed by elvans of fine-grained quartz-porphyry, which cause rapids in

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PLATE 25.

TEMPLE BAR FALL OVER GRANITITE

(IN RAINY SEASON),

KONAWARUK RIVER.

Photo by H. I. Perkins.

the river about half a mile south-west of Long Falls. The series of cataracts and rapids, known as Long Falls, extend for about a quarter of a mile, and along them coarse gneiss or gneissose-granitite is constantly exposed, a vein about twelve to fifteen inches across of black, fine-grained quartz-porphyry cutting through the gneiss at the head of the falls. The river follows a very winding course through coarse gneiss and gneissose-granitite, the bands of the latter here and there giving rise to rapids. Tacuba Falls, another long series of small cataracts and rapids, which extend for about four hundred yards, are over coarse gneissose-granitite at the head, and over grey gneiss of medium texture at the foot and lower parts.

Below Tacuba Falls the course of the river is, compared to the upper reaches, free from sand-banks and fallen trees, and, in consequence, rocks are more frequently exposed. The rocks immediately below the cataracts consist of coarse granitite, traversed about two hundred yards from the foot by a dyke of diabase about five feet across, a little below which is an exposure of fine-grained quartz-porphyry intrusive through the granitite. About a quarter of a mile below, the granitite is intersected by a dyke of diabase varying in breadth from eight to ten feet. About a mile north-east of Tacuba Falls the granitite is traversed by a belt of diorite and of quartz-mica-diorite or tonalite. This belt is about sixty yards across, and at its western side consists of a fine-grained diorite which gradually changes to a coarse-grained quartz-mica-diorite. The eastern side is much altered by weathering, and is intersected by a dyke of fine-grained diabase, about thirty feet in breadth, which gives rise to small rapids. About three-quarters of a mile from the diorite the granitite, which, varying in texture from coarse to fine, is exposed at intervals along the course of the river, is traversed by an elvan of quartz-porphyry, twenty feet in width, giving rise to small rapids, and at a distance of about one hundred yards from the rapids by a dyke of diabase about twenty feet across, the intrusive rock being of medium texture. For the next quarter of a mile of its course the river passes between great masses of coarse-grained, grey granitite, which in one place are traversed by a narrow dyke of diabase of very fine texture. Below these exposures of granitite fine-grained quartz-porphyry is visible about two hundred yards. About a quarter of a mile from the lower part of the exposure of quartz-porphyry the coarse granitite, the prevailing rock to below Temple Bar Cataracts, is traversed by two narrow bands of hornblende-schist which are about five feet and about eighteen feet, respectively, in width.

At Temple Bar, at a distance of about two miles from the junction of the Konawaruk with the Essequibo, the river falls over a mass of coarse grey granitite, and its course is interrupted by some small islands, so that it passes down three channels. When the river is very low the rock is exposed over a large area, and the difference of level between the head and the foot of the cataracts is about forty feet. The broad rounded mass of granitite exposed at the northern fall is fairly uniform in structure, having, like all the granitites of the district, a more or less distinct gneissose appearance, and showing in places dark-coloured patches consisting of basic segregations from the mass; whilst to the south of the main fall an elvan of dark, fine-grained quartz-porphyry traverses the rock.

The rocks below Temple Bar for some distance down the river consist of granitite similar to that of the cataracts, but at about a quarter of a mile north-east of them the river passes over a belt, about eighty yards wide, of very coarse-textured quartz-diorite. For about a quarter of a mile from the diorite many exposures of fine-grained diabase are seen on the banks of the river and in its channel; then for about one hundred and fifty yards a dark-grey quartz-porphyry occurs; and from it to the mouth of the Konawaruk there are frequent exposures of diabase, which are in places fine-grained, whilst the rock of the one near the junction of the Konawaruk with the Essequibo is identical in texture with that of the dykes which give rise to the Konawaruk rapids in the latter river.

CHAPTER XX.

THE DEMERARA RIVER.

The lower parts of the Demerara River traverse an alluvial district, and no signs of rocks are seen lower than Christianburg. There the mill stream cuts through a highly metamorphosed and silicified felsite or tuff, resembling an indurated clay, and which contains numerous small masses of quartz. J. G. Sawkins (p. 52 of the "Reports on the Geology," and p. 427 of vol. xxvii. of the *Quarterly Journal of the Geographical Society*) stated that about two miles above Christianburg a coarse-grained trap rock is seen near the centre of the river at low water. This I have not seen. At Three Friends and at Kumaru, near Akaima, a coarse-grained diabase occurs, while Akaima Hill consists of an altered felsite or tuff similar to that at Christianburg. There are no exposures of unaltered rock between Kumaru and Seba, the sections on the banks of the river being generally of alluvial and fluviatile deposits, although here and there granitic degradation-products occur. At Seba there is a large exposure of gneissose-granitite showing porphyritic crystals of feldspar, and containing caught-up masses of gneiss. The granitite is traversed by many veins of aplite and of pegmatite, and it forms a rounded hill of about one hundred feet altitude on the east bank of the river.

Between Seba and the Arisarabu Creek, near which is the Wallaba Quarry, for a distance of about five miles the banks of the river show in places granitic decomposition-products. The rocks at Wallaba Quarry consist of grey gneiss with intrusive veins of granitite and of aplite. Both at Seba and at Wallaba the rocks contain small red garnets, while at the latter place minute particles of pyrites, both ordinary and arsenical, and of galena are present. At intervals between Wallaba and Tiger Hill granitic decomposition-products and greatly decomposed granite or gneiss are seen. Between three and four miles north of Malali on the west bank of the river a very ferruginous sandstone, of recent origin, is visible. At Surakabra, on both banks of the river, a decomposed coarse-grained granitite is exposed for about three hundred yards. On the eastern flank of Tiger Hill, on the west bank of the river, great masses of coarse granitite are seen *in situ* at intervals for about half a mile; a broad dyke of diabase penetrates them—an off-set from the mass which comprises the upper part of Tiger Hill—about two hundred yards from the most northerly exposure of the granitite. From the south-easterly flank of Tiger Hill to the foot of the rapids at Malali there are many exposures of diabase of medium texture.

The Malali Rapids are over coarse-textured diabase at the lowest rapid, where it contains in places some caught-up pieces of granite; the rock becomes much coarser at the second and third rapids, where it contains much diallage, which gives it an appearance that probably misled Sawkins (*Quarterly Journal of the Geological Society*, vol. xxxvii., p. 427, "Geological Reports," p. 53) into the statement that the rapids were over "granitoid schist." The top rapid is over moderately coarse diabase. Diabase extends for some distance up the river beyond the rapids.

Near the mouth of the Kwitaro Creek exposures of coarse granitite occur for about a mile and a half along the course of the river. At Sericambra, near the Kwitaro Creek, the granitite is traversed by an elvan of augite-syenite, while at Kurua there is an exposure of pegmatite or graphic granite.

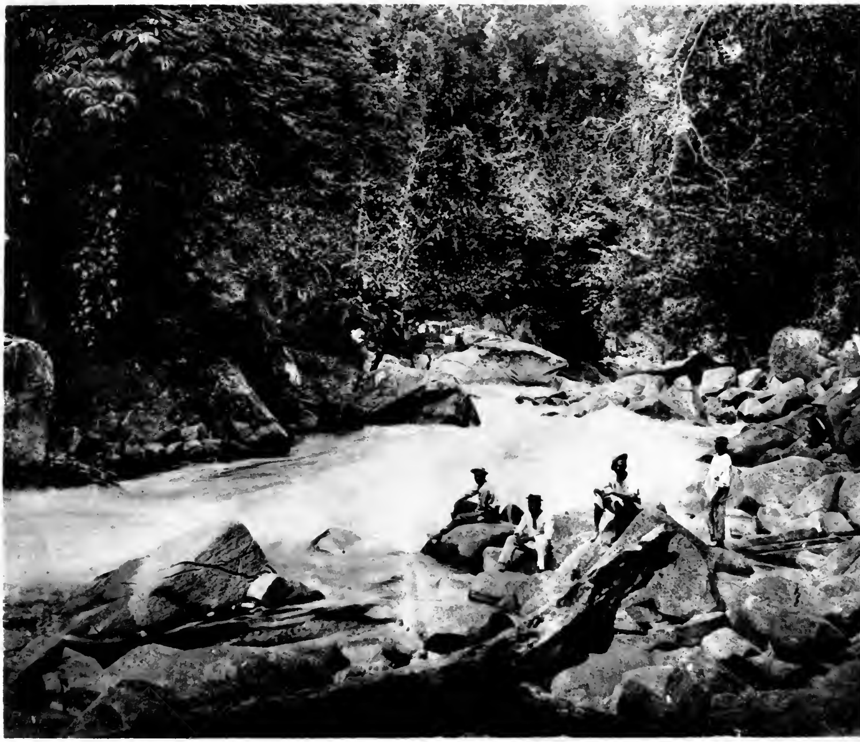
For two miles above the granitite to near Saka many exposures of diabase occur, the northerly ones trending north-east and south-west, the southerly ones striking north and south. A coarse diabase in the Marimari Creek trends up the river north and south. About a mile south of Arampa Hill, at Omakwia, a dyke, about sixty yards across, of coarsely granular diabase passes through white sandy clay, probably the residua from granitic rocks. Near Surabaro Creek a partially decomposed granite is visible, and from here to Yawarusaru similar rocks are exposed at intervals, the banks of the river generally being granitic decomposition-products.

From Yawarusaru the upward course of the river changes from a southern to a westerly one, and passes in about ten miles to the Kumaparu path, through a district frequently traversed by dykes of diabase of varying textures. In this part of its course the bed of the river and the sides of the hills are in many places covered with concretionary ironstone-gravel. The diabase from here to the Waracabra Rapids, varies in texture from fine at Sibalikabra to medium at Mecropai. At Waracabra it has a coarse structure, and it consists of quartz-diabase and of very coarse enstatite-diabase. About two hundred yards above the foot of the rapids the rock gradually changes into a fairly fine-grained one, where it is last seen at the end of the Kumaparu path.

From near the end of the Kumaparu path the river resumes its southerly course, and its banks indicate that it traverses a gneissose district. About a mile north of the great falls of Ororu Malali coarse hornblende-granitite-gneiss is exposed on the east bank and at intervals from there to the foot of the falls. The falls are caused by a great belt of diabase of very coarse texture, which cuts through the gneissose rocks in an easterly and westerly direction. The effects of the intrusive mass are distinctly noticeable on the gneiss at about fifty yards from the contact, and are very marked near it, where the gneiss assumes a granitic structure, the foliation gradually becoming obliterated. At the falls near the diabase the gneiss resembles a porphyritic granitite with crystals of orthoclase and oligoclase, with rounded outlines surrounded by hornblende and

[To face page 174.

PLATE 26.



ORURO MARALI OR GREAT FALL, OVER DIABASE,
DEMERARA RIVER.

Photo by H. I. Perkins.

chlorite after biotite. Above the falls the diabase has a coarsely granular structure, and has weathered into rounded masses. Near its contact with the gneiss its texture becomes finer, the rock weathering into angular blocks; and it gradually changes to a very fine-grained basaltic diabase, which in the places of actual contact is a very compact dense proterobase showing a fluxion structure. The intrusive diabase mass sends out many narrow veins, which split up and follow lines of weakness in the gneiss. In these the diabase is converted into an epidiorite.

The country in the neighbourhood of the Kanaimapoo, Appaparu and Darina mines consists either of epidiorite, of epidote-hornblende-schist or of quartz-schist and chlorite-schist. It is intruded into by numerous dykes of diabase which give rise to ranges of low hills. Quartz veins have been worked at these mines, but on tentative scales only.

CHAPTER XXI.

THE BERBICE RIVER.

(C. W. Anderson.)

The Berbice River from the Atlantic Ocean has a sinuous course of about one hundred and sixty miles in a general south-south-westerly direction to Yowanna Island, and passes through alluvial deposits consisting of coast alluvium, arenaceous clays and sand beds, an accurate and detailed account of which is given by C. B. Brown in Report No. 11 published in the "Reports on the Geology of British Guiana" by Sawkins and Brown, dated 1875. On the left bank of the river, opposite Yowanna Island, cliffs occur about ninety feet high, composed of red and white coloured clays and sand. About two miles above, just below Waramuri Itabu, the first exposure of rocks is seen, situated low down on the left bank of the river; they consist of an extremely hard felsite.

In the Waramuri Itabu a blackish coloured sandstone is exposed on the right bank. Near Kabouriwa inlet the river banks are formed of whitish clay, and about half a mile above Kabouriwa Creek some rocks in the river consist of a dark brownish coloured and thinly stratified sandstone.

For a distance of about four hundred and fifty yards above Kawashi Inlet a belt of epidiorite extends across the river.

Thence no rocks are exposed in the river for a distance of about eight miles up to Sirikuru Shallows, where the river flows over a belt of ferruginous conglomerate. Along this stretch of river the banks, during the dry season, are from fifteen to eighteen feet high, and are composed of broken masses of an admixture of sand and clay having a rock-like appearance.

About two miles above Sirikuru the river is joined by the Kuruduni Creek, a large tributary on the right bank. On some hills situate about two miles up this tributary beds of quartz-conglomerate occur, containing large pebbles in a siliceous cement similar to that found at the Kaieteur Falls on the Potaro River. Between the Kuruduni Creek and Muka-Muka Inlet, near the landing of a path to the Demerara River, are some rock-exposures which consist of gabbro; these are mentioned as being the first rocks observed by C. B. Brown on the river, and are described by him as "greenstone."

Below Hubudi-Kabura the gabbro has been decomposed, giving rise to high banks of ironstone containing innumerable vesicles, while between the Kairuni Creek and an inlet of the same name the unaltered rock again appears.

About half a mile above Immema-Kabura inlet is a belt of extremely compact felsite, followed by a dyke of diabase which is exposed near Kuiai Inlet. The lower edge of this diabase consists of a glassy tachylyte, a form of the rock of extremely rare occurrence in the colony. Ferruginous conglomerates and sandstones extend for the next four and a half miles to near Dallibanna Creek. At this spot diabase is seen, and extends thence for a distance of about three miles up to the Ariwa Creek.

Above the Ariwa Creek the river traverses a felsite, having a tuff-like appearance, indistinctly foliated, and varying in colour from ashy-grey to purplish and dark red.

Masses of this rock occur on either side of the river up to about three-quarters of a mile below Deringbang Creek, where they are crossed by a diabase dyke which extends a short distance beyond the Deringbang Creek, forming in it, about four hundred yards from the river, a cascade called Iduri-waddi.

Between Deringbang and the foot of the Marlissa Rapids the rocks exposed at intervals are porphyrites and quartz-porphyry.

At Marlissa, about thirty-seven and a half miles from Yowanna Island, large rounded masses of pink-coloured aplite-granite encumber the river, forming a series of narrow and shallow rapids. Many of these rocks are marked with so-called Timehri pictures—ancient writings or hieroglyphics—lightly cut on the surface of the granite.

The aplite-granite extends for about three miles to near Long Liquor Rapids, where it is succeeded by feldspar-porphyrite, which forms the rocky river bed, and extends a distance of about two and a half miles to immediately above Itabru Creek. There two masses of this rock jut out and form a narrow passage in the river, about sixty feet wide, called the Itabru Gate.

Beyond this passage the river expands, on the southern side, into a bay with a sloping sand-beach, and forms a wide basin, at the extreme end of which the Itabru Cataract falls through a narrow slanting channel cut through masses of feldspar-porphyrite. Another great mass of this rock extends from the Itabru Cataract, in an almost straight line along the northern bank of the river basin, to the Itabru Gate, the weathering of which shows a globular structure, the balls varying from one to three inches in diameter, being closely and firmly cemented together. The masses of grey and reddish feldspar-porphyrite on the south side of the cataract consist of a much-jointed and compact variety breaking into squares and cuniform pieces.

The feldspar-porphyrite extends for about half a mile beyond the Itabru Cataract, about five hundred yards above which it forms the Little Itabru Cataract. A small rapid, near an island about a mile above Itabru Cataract, is formed by greyish rocks of quartz-porphyrite, and about three-quarters of a mile above this rapid the quartz-porphyrite forms two great barriers, each about eight feet high and about one hundred and fifty yards apart, forming the obstructions in the river known as the Capella and Umbrella Cataracts.

The rocks at these cataracts are vertically jointed and, on the surface, appear to have a schistose structure. Broken masses of similar rock, with numerous small outlets through which the water falls, form a cataract about half a mile beyond known as Winter's Falls. Some rocks exposed at a small rapid about a mile above Winter's Fall are green-coloured porphyrite, and about two miles beyond a long shallow reach of river, known as Savannah Rapids, is filled with small blocks of similar rock. About half a mile above Savannah Rapids a diabase dyke of about one hundred feet wide trends across the river.

Above this dyke rocks of compact felsite are exposed as far as the long and shallow rapid called "Tramway," where porphyrite forms the rocky bed of the river.

Below Manmakuri Rapid felsite also occurs.

At Manmakuri Rapid the rock-formation is feldspar-porphyrite, and varieties of this rock are exposed at S Rapids (so called from their shape), Champion Rapid, Guava Rapid, and as far as Haururaru Creek and Landing, a distance of about nine miles along the river. Just above Haururaru there is a small belt of granophyre, succeeded by felsite, which gives rise to a series of rapids known as "Tacuba Falls." The felsite along this series is much jointed at varying angles, and on the surface has a schistose appearance.

The great mass of rock forming the upper and lower parts of the Christmas Cataracts, which are about one thousand one hundred yards in length, is feldspar-porphyrite, vertically jointed in many places, and varying in colour and texture.

About the middle of these cataracts the feldspar porphyrite is traversed by an intrusive dyke of diabase about three hundred feet in width, causing a perpendicular fall of about twelve feet.

Rocks of feldspar-porphyrite are exposed at intervals in the river from Christmas Cataracts to Bullet Tree Creek.

A little below Bullet Tree Creek rocks of porphyrite form shallows and islands in the river, while at Brown Creek rocks of feldspar-porphyrite occur.

CHAPTER XXII.

THE STRUCTURES OF THE AURIFEROUS DISTRICTS.

(*a*) *The North-Western District.*—The North-Western district extends from Koriabo on the Barima River, Hoorie Creek on the Barama River, and the Turabang Creek on the Waini River, on the east, to the frontier of Venezuela on the west, and has an average breadth of about thirty-eight miles, whilst its area is somewhat over three thousand square miles. The gold-bearing formation extends on the west into Venezuela. It is probable that more extended prospection will materially add to its recognised area in British Guiana. In addition to the main area of auriferous rocks in the North-Western district there are small outliers of similar rocks such as the Aruka Hills and the low hills, Mount Everard and Mount Terminus.

The most north-easterly exposures are the Aruka Hills. These consist of epidiorite which passes in places, as at Maburima and near the Indian Portage to the Arikita, into hornblende-schist. Whilst "colours" of gold are readily found in the gravels of the small streams which have their sources in these hills, as far as it has been examined the range cannot be considered as likely to be the source of payable alluvial deposits. The rocks which compose the range are auriferous, their contents of gold varying from traces to about 34 grains of the metal per ton of the rock.

Colours of gold have also been obtained from the laterites of Mounts Everard and Terminus and of Koriabo, the two former being residuary deposits from hornblende-schist, the latter from diabase.

The sources of the alluvial gold in the North-Western district are the residuary deposits from epidiorite and hornblende-schist, diabase, and in places, for instance, near Arakaka and near Hoorie Creek, from sericite-schist.

The best known part of the district is the Arakaka Goldfield. It is here difficult to distinguish between the laterite derived from epidiorite and the basic schists and that from diabase, but in places this can be done. For instance, near the Government Reserve at Arakaka the red clays and accompanying concretionary ironstones have been derived from epidiorite and basic schists, while those near Monkey Hill have been derived in part from them, and in part from diabase.

The Arakaka Creek flows through a valley, the lower parts of which contain gravels derived from the residua of epidiorite, hornblende-schist and diabase, and, in places, from acidic rock such as sericite-schist. In the Barima Mine district the higher parts of many of the hills consist of diabase and its decomposition-products, while the deeper parts of the numerous small valleys and ravines are cut into the decomposition-products of the basic schists. In many places it is not possible to ascertain which of the basic rocks were the principal sources of the auriferous deposits, as the country consists of a belt of epidiorite and hornblendic schists intersected by numerous great dykes of diabase.

The trend of the older basic rocks is north-north-west and south-south-east, whilst the dykes of diabase run approximately north-east and south-west. East of Arakaka, as at Manikuru, the older rocks have been the main sources of the auriferous deposits.

The alluvial gold deposits in the valleys in the southern part of the district, from north of the Takutu Creek to Mazawini, on the Barama River, have been derived mainly, if not wholly, from hornblende-schist and similar rocks.

The alluvial deposits in the western part of the North-Western district have, as far as they have been examined, for their source hornblende-schist and other rocks closely allied to it. West of the Towakaima Falls, on the Barama River, the gold-bearing rocks are principally epidiorite and its allies.

Rocks of the same group are sources of gold in the Lower Barama district, but in the neighbourhood of Hoorie Creek sericite-schist is the source.

Auriferous Quartz Veins.—The epidiorite and the hornblende-schists are traversed in many places by thin veins of quartz, and these, not unfrequently, are more or less auriferous. The basic rocks of the district contain, in addition, small quantities of gold diffused through them. In many places the older basic rocks and the later intrusive diabase have been subject to decomposition to great depth, and where this is the case, in place of small stringers and thin veins of quartz, the reddish ochreous clays resulting from the decomposition contain more or less extensive lenticular masses of quartz, some occurring over sufficiently large areas to be worthy of the term "quartz reef." The decomposition of the ferro-magnesian minerals leaves their oxides of iron either entirely diffused through the mass of the decomposition-products, giving to them their characteristic colour, or in part segregated out into pisolitic grains and masses of concretionary ironstone. The gold originally diffused through the basic rock has been taken into solution by percolating waters, and precipitated therefrom either on the surfaces of minute specks of the precious metal, or with the silica of the decomposed rock on the thin stringers of quartz which were in the original rock, converting them into more or less extensive lenticular sheets of auriferous quartz.

The quartz reef at the Barima Mine has been traced from the decomposed residua of both basic and acidic rocks into the undecomposed rock, a rather light-coloured actinolite-schist. The country about the Barima, and the neighbouring mines, is an ideal one for the occurrence of auriferous quartz reefs as it consists of epidiorite and hornblende-schist intersected by numerous dykes of diabase.

(*b*) *The Groete Creek, Cuyuni, Mazaruni and Puruni Rivers Districts.*—These extend from the Salt Creek in the Groete Creek, its north-eastern extremity, to the sources of the Kopang River in the north-west, a distance of about sixty-five miles; in a south-westerly direction from the Salt Creek to the Issano River, a tributary of the Mazaruni River, a distance of about seventy-five miles; from the

Issano River in a north-north-westerly direction, a distance of about forty-five miles, to the Kartuni River; and from the latter for a distance of nearly thirty-five miles to the head of the Kopang. The area of this district, as far as it is known, is approximately one thousand square miles. The small auriferous fields on the Kaburi River, the Samang River and the Isenaro Creek have a combined area of about one hundred and sixty square miles. The main source of the alluvial gold in the district is, as in the greater part of the North-Western district, the older basic rocks now represented by epidiorite and hornblende-schist. A broad belt of these rocks extends in a south-westerly direction from the Blue Mountains, south-west of the Groete Creek, to the neighbourhood of the Issano River, a distance, as the crow flies, of about eighty miles. Many placer claims occur along this belt, while in it, near the western bank of the Puruni River, the great mass of highly auriferous quartz worked at the Peter's Mine occurs. As far as is known diabase is not of much importance as a source of placer gold in this district, but in the area between Tinamu and Paiyuka Cataracts on the Cuyuni River the extrusion of three or more great diabase-dykes has resulted in the mineralisation of the granitite-gneiss through which they have passed.

In the north-westerly part of the district liberation of the placer gold is the result of the decomposition of relatively more or less acidic schistose rocks, and of consolidated tuffs and chloritic-felsites. As a general rule the placers in this part of the district are not very productive.

Near the Warden's reserve, south-east of Arawak Matope Cataracts, placer gold has been derived from sericite-schist and the masses of quartz contained in it.

The source of gold on the Samang River is probably the residuary deposits from diabase; while that in the rich placers formerly worked by Barnard & Co., near the Isenaru Creek, comes from a mica-gabbro.

Gold occurs in very minute quantities in rocks of all types in the Mazaruni River district, but it is seldom sufficiently concentrated in any of them to give rise on their decomposition to payable placer-deposits.

(c) *The Essequibo, Potaro, Konawaruk and Demerara Rivers District.*—The principal auriferous area in this district is the highly productive one which extends from Ararapira Point on the Essequibo River, to the first cataracts on the Kuriebrong River, a distance from east to west of about forty miles; from the south-west end of the Arisaru Range in a south-westerly direction to somewhat south of Two Mouth on the Konawaruk River, a distance of a little more than forty-five miles; from the latter place in a north-north-westerly direction to Pakatuk Cataracts, a distance of about seventeen miles; and in a northerly direction for nearly twelve miles from Pakatuk to the lowest cataracts on the Kuriebrong River. This very important area, in round figures, extends over four hundred and fifty square miles. There is also a less important and much smaller area near Akaiwanna on the Essequibo River between Twasinki and Great Itanime Rapids, which covers some sixty square miles. On the Demerara River the only district of any importance is the small one comprising about thirty square miles in the neighbourhood of the Kumaparu Rapids, and in which the hitherto only partially developed mines at Darina, Appaparu and Kainaimapu are situated.

On the Berbice River there is a small area, of which it is not possible to estimate the extent, lying between the Kuruduni Creek and the Iduriwaddi Cascade, which is somewhat auriferous, but, as far as is known, not in any place to a payable extent.

The geological structure of the Essequibo-Potaro-Konawaruk district is far more complicated than are those of the districts situated to the north-west of it. The placer gold has arisen from the degradation of the older basic rocks, of the more recent diabase, and largely in places from that of mineralised masses of acidic intrusives.

Towards the north-east of the district colours of gold have been found in the gravels of the streams flowing from the Arisaru Range. The metal has been here derived from the degradation of the diabase of which the hills consist.

The district between Ararapira Point and Kumaparu Point is remarkable on account of the numerous, relatively narrow dykes of diabase which traverse it. The diabase of these dykes always contains minute proportions of gold diffused through the rock, whilst in places at the edges of the dykes I have found that the proportions present amount to from one to three pennyweights of gold to the ton of the rock. This part of the district appears to me to be worthy of more extended examination than it has yet received.

Our knowledge of the geological structure of the Omai District is more complete than it is of any other part of the colony. This is due to the very extensive exploration work which was carried on by the German Syndicate, and to the readiness with which their local agent, the late Honourable J. H. de Jonge, placed at my disposal the details of the work and large collections of the rock-cores obtained by borings put down, by the use of diamond drills, to depths of somewhat over one thousand feet. Dr. Emil E. Lungwitz, of New York, who for some years was in charge of the development work at Omai, presented to the colony in 1901 a collection of drill-cores from the bore-holes which were sunk under his superintendence at Omai, whilst he described its geological structure in his monograph "Uber die regionalen veranderungen der Goldlager-statten," and in the "Zeitschrift für praktische geologie" for July, 1900. Mr. E. G. Braddon also added to our knowledge in his paper entitled "British Guiana and its Mining Development," published in *The Mining Journal, Railway and Commercial Gazette*, May and June, 1904.

The country in the neighbourhood of Omai consists principally of schistose rocks, intersected by a great roll of coarse-textured granite, which extends from Kumaka to Krabbu Rapids, a distance of about three miles. The rock varies in character and composition from a granitite, containing such small proportions of ferro-magnesian minerals as to be practically an aplite, to one containing considerable proportions of hornblende and of biotite, and approximating to a hornblende-granitite. Intercalated among the schistose rocks are quartz-diorites (probably epidiorites), epidiorites, and hornblende-schists. The mass of the schists consists of sericite-schist and of chloritic rocks, which are traversed by thin veins of epidote and zoisite, and of quartz with carbonates. In parts the schists have been more or less completely changed into epidosites. The degradation and decomposition-products of the schists closely resemble those usually formed from the basic rocks of the colony.

At Omai, these country-rocks have been broken through by a wide dyke of aplite about five hundred yards in breadth, which trends to the west-south-west and the east-north-east and dips towards the north. The aplite has been mineralised to a very marked extent, and in parts consists largely of sericitic mica and quartz, there approximating in composition to a greissen or to beresite. The original ferro-magnesian minerals appear to have been sparsely and irregularly distributed through it, and are now represented by wisps of much-altered biotite which are present in places in very small quantities, and by occasional aggregates of epidote with chlorite and extruded iron-ores. In places, the aplite, during its intrusion, took up and absorbed some of the basic country-rocks, and there it contains small plates of a pale-blue hornblende, and large aggregates of biotite altered to patches of pale-green biotite, chlorite, and epidote, with here and there much separated iron-ore.

The mass of the aplite consists essentially of quartz and plagioclase, principally albite, with abundant secondary white mica or sericite, which occurs in the feldspar-plates in the form of tufts and rosettes; in places, the sericite is associated with carbonates. Scattered through the mass are some grains of magnetite and of titaniferous iron-ores, many patches of carbonates, and crystals of pyrite. It is traversed by very numerous thin veins and layers of quartz, the former, seldom exceeding fractional parts of an inch in width, preponderating. Gold occurs in small quantity all through the aplite in connection with grains of cupriferous pyrite; it is fairly evenly distributed through the rock, but it is markedly more abundant near the veins of quartz, and near those places where it is traversed by tongues of diabase, than elsewhere.

The schistose rocks, the aplite, and the great granite-dyke at Kumaka and Krabbu are intersected by dykes and by great masses of diabase. This rock is intrusive in them, and at Omai, the schists and aplite were formerly covered by it. It is not possible to definitely state whether there was only one outburst, or there were repeated intrusions of diabase, but the extensive mineralisation the aplite has undergone renders the latter the more probable. The aplite weathers into a greyish, or, in places, a yellowish sandy clay, easily distinguishable from the ochreous-red decomposition-products of the schists and the deeper red ones of the diabase.

The Omai Goldfield has yielded from the small area of about forty-five acres which has been worked 58,794 ounces of gold during the years 1892–1907.

The Potaro Goldfield is situated in the valley of the Mahdia, a fairly large tributary of the Potaro River, flowing in a north-westerly direction and joining the Potaro above and at a distance of about three miles south-west of the Pakatuk Falls. The valley lies between two convergent ranges of mountains, the higher parts of each of which show bare, more or less precipitous cliffs standing out from the surrounding forest. The main masses of the mountains are of diabase, the western one being capped with sandstone. They are about two thousand feet in altitude. The lower part of the eastern range consists everywhere of diabase, but above the Strong Hope Placers, at an altitude of about one thousand three hundred feet, a mass of granitite-gneiss, some two to three hundred feet in thickness, occurs, and is covered by about six hundred and fifty feet of coarse-textured diabase. The contact-rocks of the granitite-gneiss consist of epidiorite and of quartz-diorite of varying texture, resulting from the absorption of parts of the included mass by the diabase. Near the contact of the gneiss with the diabase the resultant rock is in places auriferous to a marked degree, the samples I examined which were taken from the tunnel of the Growler Mine, situated on the margin of the granitite mass, yielding from seven to thirty-two pennyweights of gold per ton of the rock. The epidiorite contains cupriferous pyrites in large quantities.

The diabase of the district is intrusive over a large area, through more or less schistose quartz-porphyries and porphyrites. In places near the contacts of these rocks with the diabase they are mineralised to varying extents, and I have examined various samples taken from near the Mahdiana Workings of the Inflexible Syndicate, which yielded at the rate of from two to fifteen pennyweights of gold to the ton of the rock. Near Hope Placer and near the District Hospital a belt of mineralised, coarse-grained augite-granophyre occurs, which yielded, upon assaying, gold at the rate of one and a half pennyweights per ton.

The district to the east of the valley of the Mahdia, in which the Konawak and Tiger Creeks Placers are situated, consists mainly of quartz-porphyries and of porphyrites, through which great masses and dykes of diabase are intrusive. The Tiger Creek crosses, at about a mile above the Tiger Creek Falls, a belt of granitite-gneiss which extends for about two miles to the Top Falls of that creek. A reef of granular white quartz traverses quartz-porphyry near its contact with diabase at the Garnett Syndicate Placers on the head waters of Tiger Creek; the quartz is auriferous, various specimens from it having yielded to assay from two to sixty-nine pennyweights of gold per ton of the rock. The Mahdia valley is separated at the south by a ridge of more or less compact quartz-porphyry and intrusive diabase from the head of the valley of the Minnehaha Creek, a tributary of the Konawaruk River, to which it flows in a south-easterly direction.

This stream has many tributary creeks and its valley rapidly widens as it approaches the Konawaruk. Several shallow shafts and drifts have been driven into the country-rock near to and at Ironside Placer in this valley. Here the contact-rocks derived from quartz-porphyry and diabase are mineralised, but to very varying extents, as upon assaying their contents of gold were found to range from about one and a half to three hundred pennyweights of gold to the ton of the rock. One drift was driven into a mass of mineralised granite or gneiss, and samples from it yielded at the rates of from ninety-five to one hundred pennyweights of gold to the ton.

Although in the Potaro, Tiger Creek and Konawaruk Goldfields no evidence was obtained of the existence of the older, more or less schistose, basic rocks—epidiorite and hornblende-schist—their presence, but in quantities subordinate to that of the more recent diabase, is clearly shown in places near these goldfields; as, for instance, in the neighbourhood of the Ekureparu and of the Oewang Creeks, west of the mouth of the Mahdia Creek on the Potaro River, and near Two Mouth and Willis' Landing on the Konawaruk River. The rocks from these places are auriferous, those from the Konawaruk River yielding upon assaying about two pennyweights of gold per ton.

The structure of this goldfield indicates that its main source of placer gold was the enormous mass of diabase, through which have been eroded the great valleys of the upper Konawaruk, Minnehaha, Mahdia, and Tiger Creeks; whilst the subordinate sources were the older basic rocks, originally gabbro or diabase, and the mineralised belts of acidic rocks. Probably the occurrence of the latter in places has given rise to some of the very rich placer workings of this goldfield.

The small goldfield in the neighbourhood of Akaiwanna is situated in a gneissose country traversed by a belt of epidiorite, and intersected by great dykes of diabase. Here the source of the placer gold was the decomposition and degradation of both epidiorite and diabase.

The unimportant auriferous area near Kumaparu Rapids, in the Demerara River district, occurs in a country of gneissose rocks with, as near Darina, areas of hornblende-schist and, as near Appaparu, of quartz and chlorite-schist; through this country enormous outbursts of diabase have taken place, this rock being present in great abundance in the forms of bosses, dykes, and sills. At Kanaimapoo, about a mile north of the Great Falls on the right bank of the river, quartz-veins have been worked for gold with not very satisfactory results. The principal vein ran through a dark-red clay derived from diabase or from epidiorite into an epidiorite derived from a gabbro or diabase-gabbro, whence the miners followed it into an altered granitite intersected by quartz-porphyry, and changed in places into a chloritic rock. The vein where it traversed the red clay always contained gold, generally in small and varying quantities, but in places in fairly rich pockets; its average contents was about two and a half pennyweights of gold to the ton. But near the junction of the epidiorite with the granitite the quartz was richer in auriferous pyrite and in free gold, and contained as much as thirty-seven pennyweights of gold to the ton. When followed into the granitite it was found to be practically barren.

On the Berbice River there is a small area of somewhat auriferous nature, the country rock of which is a gabbro more or less changed to epidiorite.

CHAPTER XXIII.

QUARTZ VEINS AND MINERALISED MASSES.

Quartz Veins or Reefs.—The auriferous quartz veins, or so-called reefs, of the colony occur in the majority of cases where the country consists of gneiss traversed by belts of epidiorite, or of hornblende or chloritic schists, through which numerous intrusions and outbursts of diabase have taken place.

North-Western District.—Quartz veins are of common occurrence in the neighbourhood of Arakaka, in the North-Western district. This district consists of more or less acidic schists of very varying character, but generally sericitic, which are bounded on the north-west, at Mekoreusa or Eclipse Falls, by a great roll of gneissose granite, and are traversed by belts of epidiorite changed in places to hornblende and to chlorite schist, through which numerous dykes and sills of diabase have been intruded. No quartz veins occur in the diabase whilst in the unaltered epidiorite and hornblende-schist, only, as a rule, narrow veins and stringers of quartz are found. But veins and lenticular masses of quartz which are, not unfrequently, rich in gold are of common occurrence in the decomposition-products of the epidiorite, hornblende-schist and diabase.

Veins of quartz occur in the granitic-gneiss and acidic schists, but where they are seen in the unaltered rock they are either practically barren or are auriferous only to a slight extent.

Both the structure of the district and the petrographical examinations of its rocks indicate that the schists are of earlier origin than is the granitite of the district, and that the diabase was intruded later through them. The older basic intrusions, represented by the belts of epidiorite and hornblende-schist, are more or less auriferous. The gold is present in part in the numerous threads and narrow veins of pyritiferous quartz which traverse them, but it is also present diffused through the rock. Whether the gold was an original constituent of the rock, or whether it was introduced into it during and after the granitic intrusions in the neighbourhood, it will not be possible to say until more extended examinations of the district have been made.

The quartz veins which occur in the granitite-gneiss and sericite-schist of the district are either usually magmatic quartz veins, due to granitic intrusions, or are fissure-veins. Some of the larger veins, traversing epidiorite and hornblende-schist, may be magmatic quartz veins, whilst others are fissure-veins which have been subjected to secondary enrichment. Where the country rock traversed by these veins has decomposed to a great depth their size has been largely increased, having been added to by silica dissolved from the decomposing rocks by percolating waters. At the same time as silica was thus deposited a concentration and deposition of the gold contained in the decomposing rocks took place, and thus the quartz veins became enriched in this metal in proportions varying with those present in the country rock, with the result that the veins found in decomposed epidiorite and hornblende-schist are, as a rule, richer in gold than are those found in decomposed acidic rocks. A vein at the Barima Mine was enriched so as to yield gold at the rate of thirty-one ounces to the ton. The supposition of secondary enrichment is supported by the fact that the very friable secondary quartz which, not unfrequently, forms the hanging walls of the true veins of quartz in the Arakaka district is, as a rule, richer in gold than are the veins themselves.

The veins of quartz which traverse the dark-red decomposition-products of the basic rocks are frequently very rich in gold at and near their outcrops, these parts being far more auriferous than are the remaining portions of the veins. Similarly the talcose selvages of these veins are often highly auriferous.

Cuyuni River District.—Few quartz veins were noticed during the examinations of the Cuyuni River district, and these were mainly thin segregation veins in decomposed porphyry, porphyrite, and schists derived from them. Narrow veins were seen in hornblende-schist at the Arimu Cataracts and at the Arawak Matope Cataracts. Evidence was obtained that those of the former carried gold in small amount, and that some of those at Arawak Matope were magmatic quartz veins derived from neighbouring granitic intrusions.

Veins of quartz traverse hornblende-schist at Markabu Island, and near the mouth of the Oko Creek, which yield gold in quantities varying from traces to about fifteen grains to the ton of quartz.

At Wariri somewhat auriferous quartz, in veins and as a large lenticular mass, occurred in a red clay, the decomposition-product of an amphibolite. Veins of quartz traversing quartz-diorite, near to Wariri, yielded gold upon assay at the rate of fourteen grains to the ton of rock.

Masses of quartz occur in the mineralised granitite-gneiss near Paiyuka, but are practically barren. Between Paiyuka Cataracts and Popekai Rapids the gneiss is traversed in places by pegmatite veins which pass into magmatic quartz veins. Great masses of white quartz also occur in this part of the river's course, and one at Quartz-stone Island contains numerous nests and needles of schorl. They are, so far as regards their outcrops, practically barren in gold.

The Mazaruni-Puruni District.—In the gneissose and granitic rocks, through which the Mazaruni flows in the lowest parts of its course, veins of pegmatite and of aplite passing into veins of quartz are of frequent occurrence, but with the exception of a wide vein of quartz near Kalacoon they are, as exposed, all practically free from gold. The Kalacoon vein yielded upon assay at the rate of thirty-six grains of gold to the ton of quartz. This vein appears to be an off-set from the pegmatite dyke exposed in Kalacoon Bay. Like the great majority of gold-bearing veins in British Guiana it occurs in the immediate vicinity of hornblende-schist, a belt of which is exposed at Bartika Point.

There are two veins of quartz which run through gneiss exposed in the channel of the river above Itaballi Rapids. The outcrop of one yielded gold upon assay at the rate of ten grains, whilst that of the other gave 9·5 pennyweights per ton of quartz. These auriferous veins are in the neighbourhood of a complex of diabase dykes intruded through the gneiss.

For about nine miles above Turesi Cataracts to the lower end of the Marabisi Channel the Mazaruni River traverses a country made up of quartz-diorite, more or less schistose in character, epidiorite, amphibolite and hornblende-schist, and traversed by numerous dykes of diabase. This structure appears to extend across country in a northerly direction to the Puruni River, where the breadth of the belt of basic rocks is about seven miles. The country is traversed by many veins of quartz,—the rock of the outcrops of every one of those which I examined being more or less auriferous.

Some miles further up the river at the south-west end of Issano Island there is a vein of quartz, varying from three to ten feet in breadth across its outcrop, which traverses a chloritic schist. The vein is auriferous, specimens from its outcrop yielding upon assay gold at the rate of three pennyweights to the ton of rock. It has the typical appearance of a fissure vein.

From near the mouth of Tiger Creek to near Barnard's Landing the Puruni River passes through country similar to that above Turesi Cataracts on the Mazaruni. The country is traversed by veins of quartz, all of those I examined being auriferous. Towards the northern end of this broad belt of basic rocks the great mass of auriferous quartz and the extensive quartz veins now being worked as the Peters Mine occur, the country rock of the veins being a chloritised hornblende-schist.

The Quartz Veins of the Essequibo, Potaro and Demerara Districts.—Veins of quartz, which are somewhat auriferous, occur in a gneissose country at Karati and at Saxacalli Points on the Lower Essequibo River. Samples from their outcrops yielded at the rate of forty grains of gold per ton of quartz.

In the augite-granitite rocks exposed on Black Creek Branch of the Groete Creek, and in the gneiss exposed in quarries on the Lower Essequibo River, veins of pegmatite traversing them pass gradually into magmatic quartz veins. As far as I have examined these quartz veins they are not gold-bearing. A great mass of quartz, probably of this type, is exposed on a small island near the northern boundary of the Penal Settlement. The quartz is not gold-bearing. South of Arisaru gneiss is traversed by a vein of non-auriferous quartz.

At Omai three quartz veins were discovered in a laterite covering aplite. These veins were followed for some distance from the laterite into the aplite, in which rock they gradually pinched out. They were

PLATE 27.

THE "ARZRUNI" QUARTZ REEF IN LATERITE, OMAI, ESSEQUIBO RIVER.

Photo by C. W. Anderson.

studied in detail by Dr. E. E. Lungwitz, from whose published accounts most of the following details have been taken.

The principal one—the Arzruni Reef—was about two feet in thickness, and dipped at about twelve degrees to the north-west. The other veins were approximately parallel to this one. The rock of the Arzruni Reef was of wonderful richness in gold, but the metal was very irregularly distributed through it. Large samples from it examined in the Government Laboratory in 1895-96 yielded at the rate of fifty-two and a half ounces of gold to the ton of quartz. The gold in it was coarse-grained and was accompanied by a good deal of telluride. The mineral scheelite occurred in places in the veins in some quantity. The gold was found in the vein in large and enormously rich ore-pockets, in which the metal was associated with numerous crystals of iron pyrites. The bulk of the quartz in the vein was almost free from gold. The examination of one of the rich pockets was described by Lungwitz in the following words:—

"The quartz was much cracked at the ore-pocket, and showed a good deal of 'paint-gold.' . . . The specimen was broken up, and every piece of quartz was left out which appeared to be quite free from gold and gold-ore, and assays of the quartz were obtained of from two dollars to three dollars (two to three pennyweights) per ton, whilst the test of the whole specimen had given us a result of twelve thousand dollars (six hundred ounces) or more per ton. The origin of the gold must be sought for with that of the formation of the iron pyrites, for not only at this pocket, but also at other places where this vein was opened up, it was evident that the gold ore, whether as pure gold or as tellurium ore, was closely connected with pyrites. When the pyrites crystals out of the pocket were assayed, after having been completely freed from all visible gold, the results were little better than those from the pure quartz. In the same way, after removal of the pocket, the adjacent parts of the lode were found to be poor." (Über die Regionalen Veränderungen der Goldlagerstätten,1899, p. 13.)

The aplite at Omai is traversed by very numerous thin veins of quartz, all of which are auriferous.

At the Tiger Creek Placers of the Garnett Syndicate there is a very extensive reef, or vein, of bluish quartz, which is auriferous—in places to a marked extent. This vein traverses a decomposed metamorphosed quartz porphyry. Its contents of gold was found, upon assay, to vary from two to sixty-nine pennyweights per ton of quartz. In addition to quartz, the rock of the vein contains muscovite of the sericite type. Some specimens from it have the appearance of a silicified pegmatite. It is probably an auriferous magmatic quartz vein.

At a small creek called Anderson Creek, a tributary of the Potaro River, there is a vein of somewhat auriferous quartz traversing clay, the decomposition-product of feldspar porphyrite.

As a rule, quartz veins which are auriferous appear to be far from common in the Essequibo and Potaro Goldfields, although angular blocks and great masses of non-auriferous quartz are of frequent occurrence, as, for instance, at the mouth and along the lower parts of the course of the Kuribrong River. These generally are in sericite-schists and otherwise altered quartz-porphyries and porphyrites.

Auriferous quartz veins have been discovered in the Demerara Gold-field at Kanaimapu, Appaparu, and Darina, in a district about three to four miles north of the Great Falls at Ororu Marali, and have been worked to some extent. The richest vein at Kanaimapu was in a deep-red laterite, probably the decomposition-product of epidiorite or possibly of diabase. Its average contents was about twenty-four pennyweights of gold to the ton of quartz. The principal vein occurred in a similar dark-red clay, and passed through an altered basic rock into a more or less mineralised granitite, intersected by veins of fine-grained quartz-porphyry. The quartz veins, where in the red clay, were everywhere more or less auriferous, rich ore-pockets, some yielding as much as four to five ounces of gold to the ton of quartz, occurring here and there in them; but the average contents of the principal vein was only about two and a half pennyweights to the ton of quartz. The quartz of the vein near the contact of the basic and acidic rocks was fairly rich in gold and in pyrites, assaying about thirty-seven pennyweights of metal to the ton, but the vein in the acidic rock proved to be practically barren, not yielding more than one pennyweight of gold to the ton.

The auriferous quartz veins at Darina are in epidiorite and hornblende-schist, whilst those at Appaparu traverse quartz-schist and chlorite-schist. The country in which these veins occur is intruded by numerous dykes of diabase.

Gold-bearing Mineralised Masses.—The Essequibo-Potaro-Konawaruk Gold Fields are remarkable for the occurrence in them of auriferous mineralised masses of acidic, and, in places, of basic rock.

The principal of these at present known is the one at Omai, the general geological structure of which has been already described.

The mineralised rocks at Omai consist chiefly of aplite intruded through a country of epidiorite, chlorite and sericite schists, these being also mineralised to a greater or lesser extent. The mass of aplite has been proved to a depth of nearly one thousand feet, and in its widest part has a breadth of about five hundred yards. It, in common with the country rock, is traversed by intrusive dykes, sills and veins of diabase, which at one time covered the district, but has since largely been removed by decomposition and detrition.

The altered aplite has a specific gravity of from 2·69 to 2·75, and is a light-greyish coloured, fine-grained granitic rock, containing veins of quartz and of carbonates, with small crystals of cupriferous pyrites generally, though very irregularly, distributed through them. It is made up of very abundant clouded plates of plagioclastic feldspar, largely albite, in places some small plates of orthoclase and a little micropegmatite; irregular patches of original quartz showing strain-shadows which are, in places, more or less granulated; many interstitial patches of secondary quartz; a very few small wisps of more or less altered, generally chloritised, biotite; and some grains of magnetite and of titaniferous iron ore. Practically all the feldspar-plates contain secondary muscovite (sericite) in abundance in the forms of tufts and rosettes, whilst in parts the original alkali feldspar of the rock is replaced almost entirely by patches of sericite. Small granules of epidote and of zoisite are present in parts of the aplite in some abundance, but these minerals are, as a rule, only sparsely distributed through the rock. Some parts of it contain only a few plates of carbonates, in others they are abundant, whilst in places they, in company with quartz, form veins traversing it. Cupriferous iron-pyrites in the form of small cubical crystals occurs all through the aplite, in parts being only sparsely distributed, in others, especially in and near the veins of carbonates and quartz, being present in relative abundance.

The patches of original quartz in the aplite generally show strain-shadows, whilst the lamellæ of the feldspars are usually bent and not unfrequently broken.

Some of the specimens from the deeper parts of the mass of the aplite have more the characteristics of a granitite than of an aplite. They contain a few plates of a pale-blue hornblende, a few laths of muscovite, and many patches of biotite—much altered and largely changed to aggregates of pale mica, chlorite and epidote, with, in places, the extrusion of a good deal of magnetite.

The portions of the mass richest in ferro-magnesian minerals, when examined in thin slices under the microscope, supply evidence that these minerals represent portions of the country rock through which the aplite was intruded, and that they were taken up and absorbed by it.

Two complete analyses of the aplite have been made in the Government Laboratory with the following results:—

	Much altered.	Little altered.
Silica	57·96	68·14
Alumina	17·43	12·39
Iron peroxide	·45	·96
Iron protoxide	1·82	3·84
Magnesium oxide	2·34	1·38
Calcium oxide	5·07	2·36
Sodium oxide	5·17	3·08
Potassium oxide	·45	·59
Water	1·04	2·63
Carbonic anhydride	6·32	1·56
Titanium oxide	1·21	·33
Zirconium oxide	N.D.	Nil.
Phosphoric anhydride	0·2	trace.
Chlorine	N.D.	·01
Iron sulphide	0·33	2·35
Cobalt oxide	N.D.	Nil.
Manganese oxide	—	·44
Barium oxide	N.D.	·08
Copper oxide	trace.	trace.
Lead oxide	N.D.	Nil.
	99·61	100·14

The carbonates present in the first of these were separated and were found to amount to 14·33 per cent. of the rock. They were made up of 3·03 of iron carbonate, 8·89 of calcium carbonate, and 2·41 per cent. of magnesium carbonate.

The rock is essentially an aplitic phase of the widely distributed rock named by J. E. Spurr "Alaskite," which is not unfrequently auriferous. Probably the Arzruni quartz reef at Omai, which contained gold, with tellurides, iron pyrites and scheelite, was an example of a highly auriferous magmatic quartz vein traversing alaskite.

Many samples of the mineralised aplite were examined in the Government Laboratory, and, where free from veins of quartz, yielded upon assay at the rate of from one to eighteen pennyweights of gold per ton of the rock. The greater number of them, however, yielded only at the rate of from one and a half to two and a half pennyweights of gold per ton.

I have made most careful microscopical examinations of many slides cut from the aplite at Omai, and have failed to find in them any indications that the aplite was enriched by injections of micropegmatite after it had attained a pasty state; but the numerous veinlets of quartz which traverse it may be, in part at any rate, the final consolidation products of the original intrusions, and as they are markedly richer in gold than is the bulk of the rock, the residual quartz-bearing solutions which gave rise to them may have carried the precious metal in higher proportion than did the mass of the intrusion.

The Omai aplite shows signs of two changes:—

(*a*) Metamorphism, resulting in the production of sericite in abundance, and the almost total conversion of alkali-feldspar into muscovite. This change appears to have been accompanied by an infiltration of quartz and probably of part of its gold.

(*b*) Infiltration, probably from the decomposition of the diabase above it, of the carbonates of calcium, magnesium and iron, with silica and auriferous pyrites. This was probably accompanied by enrichment by gold derived from the diabase; whilst, as shown by Dr. Lungwitz, the undecomposed mass of aplite was further enriched by downward infiltration of the metal from the mass of aplite, now decomposed, which covered it.

The quartz-diorite and epidiorite of the country, at Omai, generally do not show signs of having been affected to any marked degree by the intrusion of the aplite, they are traversed, however, by thin veins of quartz, and in places by white and yellowish-white veins of a coarsely crystalline mosaic of zoisite and epidote, with some calcite and very thin films of quartz.

The epidiorites and quartz-diorite, probably, were derived from a basic hornblende-porphyrite, some of which, in a slightly altered condition, was traversed in the deeper parts of a bore-hole driven through aplite into epidiorite at Omai.

At some distance from the aplite the country consists largely of chlorite and of chlorite-epidote schist. These are highly metamorphosed, and offer no reliable evidence as to their origin. They are traversed by thin veins of quartz and of carbonates, and by others of epidote, zoisite and carbonates. They contain numerous patches of carbonates and a few minute cubes of pyrites.

In a few places the bores at Omai traversed layers of sericite-rock and of sericite-schist. These appear to have been originally feldspar-porphyrite, possibly apophyses from the aplite mass.

The diabase of Omai is a normal ophitic diabase, varying in texture from coarsely crystalline, approaching gabbro in structure, to fairly fine-grained. Where narrow veins of diabase traverse the country rocks it is either of the tholeite type or a very fine-grained augite-porphyrite.

Assays of average samples of the different varieties of rock of the cores from the holes were made in the Government Laboratory, with the following results in grains of silver and gold per ton (2,240 lbs.) of the rock :—

Kind of Rock.	Silver.	Gold.
Epidiorite	15	2
Epidote-chlorite-schist	10	trace
Sericite-schist	5	43
Feldspar-porphyrite	trace	trace
Aplite (bore-hole No. 2)	31	5
Aplite (bore-hole No. 1)	36	24
Diabase	4	2

These figures indicate that the contents of gold in the rocks near Omai vary with the degree of sericitisation to which they were subjected.

While the country at Omai is in accordance with that of the district generally, it differs from it in a very important respect—the epidiorites and chlorite-schists, which are the country rocks, have been intruded into by a mass of aplitic granitite, which appears to be the main source of the gold at Omai. This forms a great boss in the midst of the country rocks. During its intrusion many of the already formed crystals of feldspar in it were bent and broken, the mass probably having then been in a pasty state. Whether or not the aplite was mineralised before and during its passage through the schists it is not possible to say, but the prevalence of epidote in the country rocks in its vicinity points to marked metamorphism having taken place in them, whilst it took up and absorbed in places more or less of the country rocks. After the intrusion of the aplite the district was subject to a great outburst, and probably to repeated outbursts, of diabase. The aplite was underlain, intruded and covered by diabase. The diabase is at present in an ideally fresh condition, whilst the presence of secondary minerals, especially of white mica, in the aplite points to its having undergone profound metamorphism.

Near Smith's Post Island on the south-eastern edge of the granitite belt at Kumaka, on the north-western side of which Omai is situated, a mineralised aplite or alaskite also occurs. The rock is of specific gravity 2·7, and has the following composition:—

	Smith's Post Island.
Silica	68·99
Alumina	18·29
Iron peroxide	2·10
Iron protoxide	1·62
Magnesium oxide	·40
Calcium oxide	4·75
Sodium oxide	3·15
Potassium oxide	·09
Water	·14
Carbonic anhydride	1·10
Titanium oxide	trace
Phosphoric anhydride	·004
Iron sulphide	·004
Manganese oxide	Nil.
Copper oxide	Nil.
	100·638

The rock is a rather compact greenish one with small white specks of feldspar, and with here and there veins of calcite and others of quartz. It possesses a granitic texture, and consists of cloudy patches of oligoclase with inclusions of epidote and sericite; irregular patches of quartz, which are generally granulated, the larger ones showing strain-shadows; scattered patches of epidote with chlorite; and some grains of titaniferous iron with leucoxene; whilst carbonates are present as alteration-products.

The carbonates in it consist of 1 per cent. of calcium carbonate and 1·26 per cent. of magnesium carbonate.

The Smith's Post Island mass of alaskite proved to be non-auriferous at its outcrop; but as Lungwitz's observations showed that in the outcrop of the aplite at Omai, at "about ten feet from the tunnel mouth the proportion of gold was nil, something like fifty feet from the starting point of the tunnel it was just demonstrable, and about ninety feet into the interior just weighable; from now on, the decomposed mass changed gradually into aplite, and the contents of gold in this, as it passed into rock, quickly increased," its barrenness there cannot be accepted as proof that the deeper parts of it may not be auriferous.

Like the Omai mass the Smith's Post aplite shows no signs of impregnation with micropegmatite.

Near the Mahdiana Workings of the Inflexible Syndicate, south-east of the present camp, a cut was made through compact felsite into a coarse-textured granophyre, which is intersected by numerous narrow veins of quartz, and contains much iron pyrites. Samples of the granophyre which were assayed yielded at the rate of from two and one-eighth pennyweights to as much as fifteen pennyweights of gold to the ton of rock.

The granophyre consists of a ground mass of micropegmatite, containing much quartz, in which are numerous broad plates of labradorite generally much clouded and containing sericite, a very few granules of augite with biotite, epidote and chlorite (delessite) in patches, some grains of titaniferous iron, much leucoxene in small aggregates, a few prisms of apatite and some patches of carbonates with many grains of pyrite. It is traversed by the veins of secondary quartz containing numerous small cubes of pyrites.

The granophyre has the following composition :—

Silica	75·62
Alumina	14·05
Iron peroxide	·33
Iron protoxide	2·82
Magnesium oxide	·40
Calcium oxide	2·79
Sodium oxide	1·97
Potassium oxide	·44
Water	·26
Carbonic anhydride	·93
Titanium oxide	traces
Phosphoric anhydride	·009
Iron sulphide	·06
Manganese oxide...	trace
	99·679

The sample analysed yielded at the rate of fifty-one grains of gold to the ton of rock.

Near Hope Placer and on the Potaro-Konawaruk Road, near the hospital, masses of coarse-grained granophyre occur. These contain veins of carbonates, with many crystals of iron and copper pyrites and of galena. Specimens from near the hospital were found to yield gold at the rate of thirty-three grains per ton.

The granophyre is a dark-coloured compact rock, having a specific gravity of 2·72. It is made up of large and broad plates, and smaller laths of plagioclase, in a ground mass of micropegmatite and interstitial quartz. The larger plates of feldspar are, in parts, sericitised, and are, in many places, deeply corroded into by the micropegmatite, whilst the smaller ones are of later origin and have crystallised out from it. As accessories, it contains patches of delessite, some grains of titaniferous iron-ore, small aggregates of leucoxene, a few prisms of apatite, and, in places, many small cubes of pyrites. It is traversed by thin veins of carbonates, which mineral occurs also in patches.

The mineralised masses at Inflexible and near Hope Placer, in the valley of the Mahdia, show evidence of the intrusion of quartz and feldspar after the partial solidification and alteration of the feldspar of the original pasty mass. These rocks are now granophyres, with clouded sericitised crystals of plagioclase-feldspar, surrounded by clear micropegmatite. The gold which is diffused through them was probably brought into them by the magma of highly quartziferous micropegmatite. The carbonates of calcium and magnesium present in the rock are probably infiltration-products from the great masses of diabase which once overlaid them, and which are now represented by great depths of laterite in the forms of more or less auriferous red and ochreous clays and concretionary ironstone, whilst the gold in the granophyre may have been enriched by infiltration of some of that originally present in the diabase, and by impregnation during its extrusion.

Mineralised masses occur at and near the Ironside and Providence Placer workings in the Minnehaha Valley. These are mineralised porphyry, aplite and granitite, and in parts are very rich in the precious metals. The mean contents of the samples examined in the Government Laboratory were sixty-five pennyweights of gold and twenty-three pennyweights of silver per ton of the ore, but the proportions varied widely in different samples—from thirty-one grains to three hundred pennyweights of gold, and from twelve grains to one hundred and fifteen pennyweights of silver.

Samples of mineralised and weathered granitite from Providence yielded from ninety-five to one hundred pennyweights of gold per ton of the rock.

The original mineralisation of these masses resembles that of the Omai aplite, and is due to similar causes, and, in addition, the rocks have undergone enrichment during the extrusion and the subsequent decomposition of the vast sills of diabase through which the valley of the Minnehaha have been eroded.

In places in the Potaro gold district mineralised masses of basic rocks occur. One of these is at the Growler Mine, situated about one thousand three hundred and fifty feet above the valley of the Mahdia, on the Eagle Mountain range. It consists of epidiorite of varying texture, passing to quartz-diorite. These rocks are near the contacts of diabase with an enormous caught-up mass of granitite-gneiss. The coarser-grained varieties consist of dark-green, green, and olive-green hornblende, some biotite, a little muscovite and a few plates of augite; patches of quartz, showing strain-shadows; large plates of plagioclase-feldspar, clouded with sericite; with magnetite, sphene, a few prisms of apatite, some chlorite, and a little epidote as accessories. The finer-textured varieties of the rock contain numerous small cubes of pyrites, and are auriferous, the samples examined in the Government Laboratory yielding from seven to thirty-two pennyweights of gold, and from three to twenty pennyweights of silver per ton of the rock.

In the course of the Konawaruk River near Willis' Landing epidiorite and hornblende-schist occur, which are auriferous, yielding, upon assaying, gold at the rate of two pennyweights per ton of the rock.

In the Cuyuni River district between Tinamu and Paiyuka Cataracts an area of a more or less mineralised granitite-gneiss occurs, the mineralisation of which is due to intrusions of diabase. The gneiss is much altered by the diabase, its original ferro-magnesian minerals are completely destroyed, and are now represented by patches of minute granules of magnetite and augite, whilst the feldspars are darkened by the development of innumerable exceedingly minute glassy inclusions and gas-bubbles throughout their mass. The gneiss at some distance from the diabase yielded upon assaying at the rate of four grains of gold per ton, whilst samples taken at the cataracts from near the contacts of the gneiss and the intrusive diabase yielded at the rate of seventeen grains of gold per ton of the gneiss.

Mineralised masses of country rock such as those described are doubtless of great importance as sources of gold, especially in the central districts of the Colony.

CHAPTER XXIV.

THE PLACER DEPOSITS.

The North-Western Goldfields.—Compared with the other goldfields of the colony the contour of the North-Western district is relatively even; the creeks and their tributaries are of low grade, and hence the natural facilities for the economic treatment of placer gravels are not equal to those in the more hilly districts.

In the placers in the neighbourhood of Arakaka the gold-bearing gravels are usually covered by from two and a half to four feet of a heavy clay, ranging in colour from yellow to red, and which is frequently underlain by bluish clay resting directly on the gravel. The gravels are from two to two and a half feet in thickness, and carry approximately one and a half to two pennyweights of gold per cubic yard.

At the Manikuru Placers the gravels, as a rule, are covered by yellow to reddish clay of very varying depth, usually ranging from two to seven feet, but which, in places, are as much as fourteen feet in depth. The gravels also vary greatly in thickness, from two to seven feet, and are of about the same richness as those near Arakaka. The Warimba Placers are of similar character to those on the Arakaka side of the river.

The constituents of the gravels are quartz in great predominance, concretionary ironstone, and here and there pebbles of more or less altered basic rocks. In the upper parts of the creeks and of their tributaries the quartz pebbles in the gravels are usually coarse and angular, and show no signs of having travelled far from their places of origin. The quartz pebbles in the gravels of the lower reaches, and the flats of the creeks and streams, are also more or less angular and, as a rule, only slightly water-worn. As the river is approached the pebbles become more water-worn.

In the higher placers the gold in the gravels is coarse and in many places nuggety, while in the lower ones it is usually in fine grains, although fair-sized nuggets have been found in them. The largest nugget found in these districts weighed about ten ounces.

The placers in the higher parts of the Barima River, near the Five Stars and Jimbo Creeks have given high yields of gold. The characters of the placer deposits resemble those of the lower districts, but great boulders of epidiorite and of hornblende-schist occur in them. The gold-bearing gravels on the average are about two and a half feet in thickness. The gold found in them is usually coarse and nuggety,

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Plate 28.

PLACER WORKING.

USING A "TOM."

Photo by H. I. Perkins.

and is very irregularly distributed through them. Very large nuggets, one of which weighed 333 ounces, have been found from time to time in this district.

The placers in the Barama River Districts usually have from two to as much as eight feet of yellowish to bluish clay over the gravels. In the flatter and lower parts of the district, as near Ianna and Hoorie Creeks, in place of the clay, white quartz sand and whitish sandy clays and sericitic earths are found, their thickness being from three to four feet. The gravels consist, as a rule, of coarse, sub-angular white and bluish-white quartz pebbles, and along some of the creeks are accompanied by boulders of hornblende-schist. The gravels vary in depth from one to four feet, whilst their yield of gold varies from two and a half to four pennyweights per cubic yard, the metal being usually coarse.

The Groete Creek and Cuyuni River Placers.—The Groete Creek Placers are situated on White, Black, and Salt Creeks. They have from two to five or six feet of reddish-brown or of yellowish clay above the gold-bearing gravels. The gravels are usually about two feet in thickness, and consist of coarse and of fine, more or less ferruginous, angular pieces of quartz, with fragments of hornblende-schist and irregularly shaped pebbles of concretionary ironstone. In places the upper parts of the gravels are cemented by concretionary ironstone. The quartz of the gravel occasionally shows visible gold. The gold is, as a rule, very fine and is sparingly distributed through the gravels; but in places the pay-dirt has yielded from one to one and a half pennyweights of gold to the cubic yard.

The Cuyuni River Placers are situated on the Oko, Arawak-Matope, Arimu, Mariwa, Quartz Stone, Waiamu, St. John's and Kopang Creeks.

The Oko Creek Placers are situated twenty miles or more from the river side. In the placers near the creek the gold-bearing gravels are from one to two feet in thickness, and are covered by from five to, in some places, as much as ten feet of yellow and reddish clay. The gravels are ferruginous, sub-angular and somewhat coarse, their gold is generally fine-grained, and their yields in places have amounted to over three pennyweights of the metal to the cubic yard. The gravels on the tributaries of the Oko vary from two and a half to four feet in thickness, the red, yellow or yellowish-red clay covering them being from two to five feet in depth. The gravel consists of coarse and of fine, angular, ferruginous quartz with some large rounded stones. The average yield per cubic yard is about one and a half pennyweights of gold, which in placers on the main creeks is usually fine-grained, whilst in those in the ravines it occurs in coarse, rough pieces. These placer gravels have been mainly derived from amphibolite and hornblende-schist.

The Arawak-Matope Placers are characterised by the coarseness of their gravels and of their gold. Pieces of sericite-schist are found in them. Their over-burden of ochreous clay is about six feet in thickness.

The Mariwa Placers on the western slopes of the Blue Mountains resemble in general characters the Groete Creek Placers, but, as a rule, their gravels yield lesser proportions of gold.

The Arimu Creek placers in the lower parts of the creek, where undulating sand-hills form the country, have for their pay-dirt fine angular, white, and ferruginous quartz gravel, with, occasionally, larger pebbles of quartz. Where these pebbles show a schistose structure specks of free gold are not uncommon in them. The upper placers are situated some miles from the course of the creek, where the country consists of low hills of ferruginous clays, capped with large boulders of concretionary ironstone. In these placers the gold-bearing gravels are generally about one and a half feet in thickness, and are covered with from six to ten feet of yellow and reddish clays, with, in their lower parts, layers of white sand and clay. The gravels consist of fine and coarse, angular brown quartz, and, in places, have yielded as much as seven pennyweights of fine gold per cubic yard. In the highest parts of the district towards the water-shed, between the Cuyuni and Puruni Rivers, the overburden averages about four feet in thickness, and it rests on about two feet of gravel, which has yielded about five pennyweights of fine gold per cubic yard of the pay-dirt.

The Quartz Stone Placers are about twelve miles from the Cuyuni River. Their strippings consist of an average depth of three feet of yellowish-red clay, which is underlain by about two feet of white angular quartz gravel, intermixed with sand and clay. The quartz occasionally shows free gold. The gold in the gravels varies from fine dust to large nuggets, and shows no signs of having undergone transportation.

The Waiamu Placers are scattered over a wide area. Their gold-bearing gravel is of a coarse angular quartz, with a good deal of sand, yields about one and a half to two pennyweights of gold per cubic yard, and is overlain by about three feet of ferruginous clay.

The St. John's Placers usually have an overburden of about four feet of an ochreous-yellow clay, and their gravels—consisting of coarse, angular fragments of quartz, intermingled with pebbles of more or less decomposed felsite, and, in places, with many nodules of concretionary ironstone—vary in thickness from one to three feet. The gold found is coarse, and is very unevenly distributed.

The Kopang Placers are situated towards the head of the creek near the Barama district. As a rule the overburden of brown clay is not deep, and the gravel consists of coarse quartz pebbles which do not show visible gold. The gold obtained is usually fine-grained, and the gravel has yielded at the rate of two to three pennyweights of the metal per cubic yard of pay-dirt.

The Mazaruni and Puruni Placers.—The Puruni Placers are the more important of these. They have an advantage over most of those in other districts of the colony in being, as a rule, relatively near the banks of the river. Some are situated almost directly on them; whilst the average distance of the placers is not more than four miles from

Plate 29.

PLACER WORKING.

SLUICE AND CHINESE PUMP AT WORK.

Photo by C. W. Anderson.

the river. The overburden is a reddish-yellow to a deep red clay, varying in depth from eight to ten feet. The gravels consist near the water-side of water-worn quartz pebbles, and at a distance from it of angular to sub-angular fragments of quartz, with nodules of concretionary ironstone. In places pieces of quartz, carrying more or less free gold, are found in the gravel. The gravels yield from two and a half to three and a half pennyweights of gold per cubic yard. A nugget weighing ninety ounces was found in this district.

The only placers of importance which have been worked on the Mazaruni River are the very productive ones on the Isenaro Creek, some miles below the Peiamah Falls. The valley-placers consist of more or less angular fragments of quartz, fragments of partially decomposed granite and greenstone, with abundance of concretionary ironstone, and much ilmenite-sand. The overburden is either yellowish or red clay, and varies in depth from a few inches to three or four feet. The hillsides are covered thickly with ironstone-nodules, lying on a deep-red laterite. Both the valley gravels and the laterite yield gold. The average yield at Isenaro has been about three pennyweights of gold per cubic yard of pay-dirt.

The Essequibo, Potaro, and Konawaruk Placers.—The most northerly placers which have been worked in this district are the very productive ones at and near Omai.

The valley-gravels at Omai consisted of angular fragments of quartz, more or less rounded pebbles of concretionary ironstone, with, here and there, pieces and small boulders of diabase, epidiorite, chlorite rock, and quartz-porphyry. The gravels varied a good deal in thickness, being from one to about three feet. Near the heads of the valleys and ravines their overburden was not more than a few inches in thickness, whilst in the lower, more open, parts it was from four to six feet.

The laterite and the ironstone gravels on the hillsides are more or less auriferous; their non-auriferous overburden varies from seven to eleven feet.

The gold in the valley-gravels varied from fine dust to small nuggets. Some large nuggets were also found, one of which weighed eighty-four ounces. The average yield from the placer gravels was about two and a half pennyweights per cubic yard.

About one thousand small diamonds were found whilst the gravels in Gilt Creek were being worked.

The Potaro Placer Gravels.—The placer gravels towards the head of the Tiger Creek District are usually somewhat shallow, their overburden of brownish-yellow and red clay and loam being about two and a half feet in depth, and generally consisting of a mixture of angular white quartz with concretionary ironstone in large proportions. In some of the placers the gravels consist wholly of white angular quartz. Not unfrequently large blocks of diabase, of quartz-porphyry and of concretionary ironstone are found in the placer gravels. The average

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thickness of the gravels is from two to three feet. The gold varies from fine dust to small nuggets of two to three ounces in weight, and the gravel yields an average of about one and a half pennyweights of the metal per cubic yard.

The laterites and ironstones on the hillsides in this district are auriferous.

The gravel at the Konawak Creek Placers consisted of angular fragments of quartz, and was of considerable thickness—between three and four feet—and had an overburden of about two and a half feet of a yellowish loamy clay. It contained a higher proportion of clay, and relatively less quartz, than most of the placer gravels do. The yield of gold was high, from two and a half to three pennyweights per cubic yard. The metal was usually in fine grains, but occasionally small nuggets were found. Some diamonds of fair size and of excellent quality were obtained from these placers.

The Mahdia Valley, and those of its tributary streams, are filled with a fluviatile deposit of yellowish-brown sandy clay, varying greatly in thickness, but averaging from six to eight feet, which is underlaid by about three and a half feet of gold-bearing quartz gravel. The gravel consists principally of quartz sand, and angular quartz pebbles with some small pebbles of felsite. Blocks of more or less altered quartz-porphyry also occur in it. The average yield of the gravel is about two pennyweights of gold per cubic yard; the metal is usually in very fine grains, and nuggets weighing a few pennyweights occur occasionally. The largest nugget found in the Mahdia District weighed a little over eighty ounces.

The bed-rock in the Mahdia Valley is usually a light-coloured sandy clay, crossed in places by belts of sandy clay of ochreous to dark-red colour; the bed-rock thus clearly indicates that the deepest parts of the valley have been eroded through a country of acidic rocks, probably quartz-porphyry, intersected by dykes of basic rocks.

In this district the laterites and concretionary ironstones of the hillsides are auriferous, and payable deposits have been worked at considerable elevations. Near the heads of some of the tributary streams of the Mahdia, and in some of the higher ravines, great blocks of diabase are of common occurrence in the gravels.

The overburden in the placers in the Minnehaha District varies greatly in depth. Near the junction of the Minnehaha Creek, with the Konawaruk, the stripping is very deep, but as the creek head is approached the depth of the overburden decreases, until at its source there is none. In some of the tributary streams, near the head of the Minnehaha, the overburden is deep, and contains great blocks of diabase, whilst the gravels largely consist of partially decomposed angular fragments of that rock.

Owing to the great depth of the stripping in the lower course of the creek the gravels have not been worked to any extent. Where they have been worked the average depth of stripping is about five feet, and it consists of a reddish-brown to yellow earthy clay. The gold-bearing gravel consists of fine quartz fragments, with blocks of more or less

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Plate 30.

PLACER WORKING.

SLUICE AND TAILINGS.

Photo by H. I. Perkins.

altered quartz-porphyry and small pieces of sandstone. Towards the higher parts of the valley the gravel is coarser, and consists of rough angular quartz shingle, and fragments of partially decomposed diabase and quartz-porphyry. The average depth of the gravel is about three and a half feet, and its yield of gold is about two pennyweights to the cubic yard. In this district the gold is always very fine.

The placer gravels on the Konawaruk River are somewhat shallow, the average depth of their overburden being about two feet. This consists of yellowish clay, and is underlain by about three and a half feet of greyish-brown, very angular quartz gravel. The gravel yields on the average about one and a half pennyweights of somewhat coarse gold per cubic yard of the pay-dirt.

The foregoing brief descriptions of some of the more important placer gravels in the colony show that in few, if any, cases has the gold-bearing gravel travelled far from its place of origin. The fact that in the great majority of the gravels quartz showing gold other than "paint" gold is of somewhat rare occurrence, indicates that the source of the gold in the placer gravels ought not to be sought for in quartz reefs, but in the country rock. There are, of course, exceptions to this general rule, as in parts of the Puruni District and in some of the ravines in the Arakaka District, where the gold has been derived in part, at least, from auriferous quartz reefs and masses.

The Placer Gold.—The quality of the gold obtained from the various districts varies to some extent, as is indicated by the following:—

Placer Gold from	Fineness.
Konawaruk	891
Mahdia, Potaro	911
Groete Creek	911
Barima	912
Cuyuni	926
Puruni	935
Omai, Essequibo	941

CHAPTER XXV.

THE ORIGIN OF THE PLACER GOLD OF GUIANA.

In his work entitled "Contribution à l'étude des gites metallifères," published in Paris in 1897, De Launay stated that in French Guiana gold is often associated with diorites which, in places, have decomposed, forming auriferous earth, and that in the contested territory between French Guiana and Brazil, according to M. Bernard, gold is found in veins of quartz in diorites traversed by veins of granulite. The diorites are intrusive in gneiss and in hornblende-schist.

In a joint report with Mr. Perkins, then acting as Commissioner of Mines, published in 1897, dealing with the geology of the North-Western district, I pointed out that the source of the placer gold, and of much of the precious metal in the auriferous quartz reefs in that district was, in my opinion, the minute amounts of gold diffused in the basic rocks, to which I applied the field-term "greenstone." In March, April and May, 1898, M. Levat published in the "Annales des Mines" a work entitled "Recherché et Exploitation de L'Or en Guyane Française" in which he pointed out that the placer gold of that country has been derived from the decomposition of the diorites or greenstones, which rocks had been shown as far back as 1873, by analyses made in l'Ecole des Mines, to contain "une petite quantité" of gold. (M. Barveaux, "L'Or a la Guyane Française," "Annales des Mines," Année 1873, Nos. 30 à 35.)

Dr. E. R. Lungwitz in 1899 in his pamphlet "Uber die Regionalen Veranderungen der Goldlagerstatten," produced proofs of great importance in connection with the hypothesis of the derivation of the gold of the placers from that of the country rock (aplite) at Omai.

In the report on the geology of the Essequibo, Potaro, Konawaruk and Demerara Rivers Goldfields, dated March 24th, 1900, I pointed out that the source of gold in these districts is, as a general rule, the intrusive diabase, although in places it has also been derived from hornblende-schist, or from epidiorite. I did not lay in this report as much stress as I ought to have done on the occurrence of gold in mineralised masses of acidic rock.

In a paper published in the "Zeitschrift für Praktische Geologie," in July, 1900, on p. 217, Dr. Lungwitz wrote "There is no gold district in Guiana without diabase, and the richest portions of the Guiana gravels are characterised by the fact that the fissures in their neighbourhood which have been filled by diabase have been again occupied by aplite or diabase intrusions. The result of this was a thorough shattering of the hanging and foot walls of these dykes, the filling of the adjacent fissures by quartz, and enrichment of the soilbands by gold ores."

In a paper by Dr. Lungwitz on "The Placers of British Guiana," published in *The Mining Journal, Railway and Commercial Gazette*, 1900, he stated, as the result of "years of experience in British Guiana," that "the greater part of its placer gold owes its existence to chemical concentration."

Dr. G. C. Du Bois, in his work dealing with the goldfields of Surinam (Dutch Guiana), entitled "Geologisch-bergmannische Skizzen aus Surinam," and published in 1901, points out that there are well-marked proportions of gold in the laterites which have originated from amphibolite and augite-plagioclase rocks, and remarks that in them there is a concentration of the gold of the original rock.

In the reports of the geology and petrography of the Cuyuni and Mazaruni Districts, published in 1900, 1903 and 1905, I produced further proofs of the derivation of placer gold by concentration of the minute amounts present in the rocks during their degradation into laterite and concretionary ironstone, or to more or less ferruginous gravelly clays.

It is evident from the foregoing that there is a general consensus of opinion, among those who have studied the geology of the Guianas whilst residing in them, as to the origin of and the mode in which the placer gold has been concentrated in the so-called alluvial deposits of those countries. They consider that the gold has been derived either from mineralised masses of acidic rocks, from that disseminated through the mass of metamorphosed basic rocks, now amphibolites, epidiorites and hornblende-schists, and in part contained in thin veins or threads of quartz, which in places are more or less abundant in them, or from the minute amounts of the metal which are disseminated through unaltered gabbro and diabase.

Mr. E. G. Braddon, in his article on "British Guiana and its Mining Development," contributed to *The Mining Journal* in May and June, 1904, does not recognise the distribution of minute amounts of gold in the unaltered basic rocks, and argues that "the gold depositions follow the weakened or ruptured zones of certain pressure planes in the basic dykes, in their contact with the older acidic rocks, or in common through both," thus adopting Dr. Lungwitz's view already quoted. He, however, alludes as follows to "some of the great diabase dykes and masses of the Mahdia and Konawaruk, to which the origin of the rich alluvial gold of these river basins can be traced." As neither in hand-specimens nor in thin slices does this diabase, which is ideally fresh, show any traces of metamorphic effects, the "pressure planes" essential to his theory can only be existent in them at their contacts.

Levat lays stress in his work on the position of the placers in French Guiana with relation to the intrusive granite masses. I doubt whether in British Guiana there is any actual relationship between the great majority of the granitic inclusions and the occurrence of auriferous rocks. Certainly there is a broad belt of an intrusive granitite to the south-west of Omai at Kumaka and Kuratoka, a broad belt of a similar rock at Temple Bar to the north-eastward of the Konawaruk Placers, a very broad one at Pakatuk Falls north-west of the Potaro Placers, and a wide one at Mekoreusa or Eclipse Falls north of the Arakaka Placers, which appear to lend support to Levat's theory, but there are far more numerous instances of broad belts of granitic rocks intrusive through the gneissose and schistose rocks of British Guiana, the neighbourhoods of which are, so far as is known, free from placer deposits. Hence I doubt whether in British Guiana the occurrence of belts of granitic rocks intrusive in the gneiss or the schists offers any guide to the presence of payable placer deposits. I am, however, in full agreement with Levat in his observations that the granitic areas are themselves marked by the absence of placer-deposits upon them.

On the other hand all my work in British Guiana tends to show that the occurrence of placer deposits, of veins or reefs of auriferous quartz, and of masses of mineralised rocks are, in districts where the effects of dynamo-metamorphic forces are strongly marked and are governed by the presence of dykes of basic rocks, either geologically of very ancient origin, such as the more or less altered gabbros, epidiorites, and hornblende-schists, or, of more recent origin, the unaltered diabase.

In districts where the metamorphic forces have converted the felsites and porphyrites into well-defined schists, and the older basic rocks into amphibolites, epidiorites and hornblende-schists, and which have been subject to later intrusions of diabase, the richest placer deposits of the colony occur. Instances of this are the Omai, the Mahdia and the Arakaka Goldfields.

But the views of De Launay, Levat, Lungwitz, Du Bois, Braddon, Perkins, and myself that the basic rocks are directly or indirectly the main sources of the gold in the Guianas are not universally accepted. For instance, in their work on Ore Deposits, Phillips and Louis state that in British Guiana "Quartz veins occur mostly in metamorphic schists and gneiss, and nearly all the streams and rivers that traverse regions occupied by the above rocks or by granite are gold-bearing," whilst J. E. Spurr, in his work on the "Ore Deposits of the Silver Peak Quadrangle, Nevada," published in 1906, on pp. 149 to 151, critically discusses the various views which have been published relative to the source of gold in the Guianas, and arrives at the conclusion (p. 150) that "in British Guiana the deposition of the gold ores represents one of the closing phases of the great granitic intrusions, and that the basic dyke rocks, with which the gold ores are associated, as well as the siliceous dyke rocks, in connection with which they are also frequently found, are representatives of the general process of granitic injection, earlier than the veins, whilst subsequent to the main intrusion."

In connection with the above theory of the source of the gold in this colony it is important to note that the older gabbro, wherever found unaltered, contains in greater or less abundance areas and especially interstitial patches of a micro-pegmatite of feldspar and quartz, and that by far the greater number of specimens of diabase which have been examined show a similar structure, whilst in places the diabase passes into a quartz-diabase or into an augite-granophyre, some samples of which are gold-bearing. It is quite possible that the occurrence of gold in the basic rocks of the colony is more or less closely connected with the presence of the quartz-feldspar micro-pegmatite and that the micro-pegmatitic areas in the basic rocks may be examples on a minute scale of "magmatic quartz veins," and may have served as the feeders of gold from the magma to the iron-ores of the basic rocks.

Until far more extended and minute examinations of the British Guiana Goldfields have been made than hitherto it is not possible to accept Spurr's theory in its entirety. It is closely supported by districts having structures similar to that of Omai, but not, as far as is known, of those of other districts such as the Potaro, Puruni, and Cuyuni.

Under the conditions prevalent in the Guianas and in other parts of the tropics, where constant high temperatures, associated with very heavy and frequent rainfalls, cause a rampant growth of vegetation, igneous rocks of all types are subject to relatively rapid decomposition. The insoluble products of this decomposition, wherever shielded by forest-growth from detrition and erosion, remain *in situ* as a more or less protective cover to the deeper seated rock. Under favourable conditions this covering of more or less argillaceous material attains a great depth, for instance of as much as one hundred and fifty to two hundred feet. Many instances of these deep coverings occur in the placer districts of British Guiana.

Basic rocks of the diabase-gabbro type are very subject to chemical decomposition under tropical conditions, and, whilst highly resistent to erosion where protected from atmospheric influence, as in the beds of rivers and streams, wherever exposed are readily attacked. The action, being almost purely a chemical one, affects the sheared members of the group, such as the epidiorites and hornblende-schists, in which the numerous planes of foliation allow ready access to the interior of mass, more than it does the massive members—the unaltered gabbros and diabase—which yield only on their bounding surfaces and along their relatively few joint-planes. Hence the gabbro and diabase frequently give rise to ranges of hills and to mountains of considerable elevation, while the epidiorites and hornblende-schists are found as comparatively low rolls and domes, or are not distinguishable in the general contour of the country.

Many examinations of specimens of both classes of the basic rocks were made by Levat, Du Bois, Lungwitz and myself in order to ascertain whether they contained gold. Levat appears, from the wording of his report, to have confined his attention to the amphibolites and hornblende-schist, for which he uses the terms diorite and "grison."

He reports that the contents of gold in these rocks without being high is very appreciable, the proportions he gives for two samples which did not show free gold being, in round figures, one pennyweight and one and a half pennyweights of gold per ton, whilst he instances one sample showing free gold which yielded at the rate of fifteen pennyweights of that metal to the ton. Du Bois stated that samples taken from various diabases gave him from three to nine grains of gold per ton. Lungwitz has not, so far as I have been able to ascertain, published any figures showing the contents of gold in the basic rocks he examined, but he has stated that he has proved its presence in diabase, and in gabbro as well as in other rocks. I found gold in the diabase in proportions varying from mere traces to seventeen grains per ton, whilst I found twenty-six grains to the ton in samples taken from diabase in contact with acidic rocks.

The samples of epidiorite, amphibolite, and hornblende-schists examined all yielded gold at rates ranging from three grains to two pennyweights per ton. In order to ascertain whether the gold occurs in these rocks only in the veins of quartz which not unfrequently traverse them, I obtained from one of the poorest of them a specimen of its iron-ores which did not show the presence of free gold, and which I separated from all quartz. On assaying the iron-ores yielded gold at the rate of about five pennyweights to the ton, while the amphibolite from which they had been derived gave at the rate of only three grains.

The basic rocks alter by weathering into buff-coloured, red, brown or chocolate-coloured, ferruginous, more or less siliceous earths and clays, or laterites. These consist of mixtures in very varying proportions of angular quartz sand and grit derived either directly from the quartz present in the rock before its degradation, or, secondarily, from the decomposition of its feldspars, pyroxenes and hornblendes; of kaolinite, arising from the feldspars; and of limonite or other hydrated oxides of iron, resulting from the decomposition, hydration and oxidation of the various ferro-magnesian minerals present in the rock. In addition to the decomposition-products the laterite always contains in more or less abundance small grains of ilmenite, grains of magnetite in less quantity, some minute prisms of apatite, a few very minute crystals of zircon, and in places, a few granules of epidote. Usually the secondary quartz occurs in it in angular fragments, but in places it forms veins and lenticular sheets.

Varying quantities of the oxides of iron set free during the decomposition of the basic rocks are reduced to or are already in the state of ferrous-iron, become dissolved in percolating waters, and move through the mass of the laterite; parts may exist in solution as ferrous bicarbonate, and these, when brought under conditions in which that compound becomes dissociated, are thrown out of solution and oxidised, giving rise to coatings and layers of limonite. Other parts are held in solution by the organic acids of the tropical soil-waters and may be leached out of the laterite, but as the solution undergoes oxidation with attendant destruction of the acids the oxides of iron are deposited as limonite. The limonite forms either pisolitic grains or more commonly surrounds grains of siliceous sand, binding them together where relatively abundant into ferruginous sandstone, or, where they are less abundant, using them as nuclei for the formation of masses of impure concretionary ironstone. Some of these masses are of great size, and form blocks largely exceeding a ton in weight. In places where the concretionary ironstone has been distributed in nodules through the mass of the deposit the argillaceous matter may in time be more or less washed away, the surface becoming covered with layers of ironstone washed out from the mass. This is a very common occurrence in the auriferous districts of Guiana, where large areas of the sides and tops of hills composed of basic rocks are covered with an "ironcap." The surface layers and the great blocks of concretionary ironstone generally form ruddy-coloured, cindery-looking masses with very numerous small cavities, a structure which has caused the creoles of French Guiana to name this ironstone "roche à ravet" (cockroach-rock), the small cavities serving well for the dwelling-places of *blatta orientalis.*

In many places where the laterite and concretionary ironstone have been washed from the slopes of the hills and re-arranged by the action of running water, either in ravines or at the bottom of larger valleys, the ironstone, together with more or less of the quartz gravel, gives rise to beds of ironstone gravels and ferruginous conglomerates.

Where the bulk of the laterite consists of very finely divided particles it is very absorbent of water. When saturated or nearly saturated with water, in place of becoming plastic and tenacious as true clays do, it approximates in character to a viscous liquid, transmits hydrostatic pressure, flows more or less freely under the influence of gravitation, as on the slopes of the hills, and allows the quartz gravel and the heavier minerals to sink through it. The latter action, in places, results in the formation of beds of angular quartz gravel in the lower parts of the laterite.

During the decomposition of the basic rocks the disseminated gold in them enters into solution in the soil-waters, sinks with them into the laterite, and is either re-deposited on small particles of the metal itself adding gradually to their size, and on the surfaces and in the fissures of the quartz, whether in the form of gravel or in sheets, or becomes concentrated in the concretionary ironstone.

The concentration of the metal in the ironstone has been repeatedly proved. Levat, who first pointed out the importance of this concentration, gave a series of determinations in his work, showing that in various specimens of the ironstone the gold ranged in proportion from, in round figures, one and a quarter pennyweights to nearly fifty pennyweights to the ton. Du Bois stated that the ironstones contain from two to six and a half pennyweights of gold to the ton. Lungwitz alluded to the occasional richness of the concretionary ironstone, whilst I have found in various specimens that its contents vary from traces to as much as fifteen pennyweights of gold to the ton.

Dr. Lungwitz has produced a remarkable proof of the solubility of gold in the soil-waters. He showed that the ashes of trees that had grown on the auriferous laterite of Omai contained small quantities of gold, the proportion of gold in the ashes of the trunks of the so-called "ironwood," varying from about two to ten grains of gold per ton of ash. In the ash of the upper part of the trunks near the branches he found as much as twenty-eight grains per ton.

Du Bois, working on material grown in Surinam, was not able to confirm Lungwitz's results, and suggested that trials carried out in the conditions under which Dr. Lungwitz worked were not free from doubt.

I made the following experiments to assist in elucidating the question: Through the kindness of Mr. Dunn I obtained a piece, some seven feet in length, of the trunk of an "ironwood" tree, grown on the laterite covering the mass of auriferous aplite at Omai. This was most carefully cleaned, sections were cut off from both ends and rejected, and other sections were cut off for examination. The selected pieces were separated into the bark and the interior wood, the trunk yielding 18 per cent. of the former and 82 per cent. of the latter. These were separately burnt to ashes in a new muffle in a furnace which had never been used for gold assaying, when the bark yielded 4·78 per cent. of its weight of ash, and the wood gave only ·67 per cent. Several trials were made, using quantities of four assay tons of the ashes for each assay, and cupelling in new muffles, whilst by blank experiments, the crucibles and the materials used were proved to be free from all traces of gold. The ash of the bark yielded gold at the rate of only one grain per ton of ash, whilst that of the wood yielded in the various trials made from seven to ten grains of gold per ton of ash. Thus the trials confirmed the results obtained by Dr. Lungwitz as fully as possible, and were made under conditions of strict control, which were free from the objections raised by Du Bois to those under which the earlier ones were made at Omai.

Proof was also obtained that the waters of the Omai Creek contained gold. A sample of a rusty deposit was sent to me which had been obtained from the steel valves of one of the pumps used for producing hydraulic power for washing the laterite at Omai. Many millions of gallons of the creek water had passed through the valves, which had become somewhat corroded. The deposit was found to yield gold at the rate of one hundred and fifty-six grains to the ton. This proof, however, is not as free from objections as are the concordant results obtained by Dr. Lungwitz and by myself, which showed that the ash of the "ironwood" trees grown at Omai yielded gold in appreciable amounts. It is of course possible that the gold found in the rusty deposit of the pump-valves was present in the waters in suspension, whilst it is not possible for gold in that state to have obtained access to the *interior* wood of the tree trunk.

The fact of the solubility of gold in soil-water having been thus proved, it is easy to understand how the concentration of the metal disseminated through the basic rocks takes place during their decomposition. We are not in a position to point out exactly what are the precipitating agents in the laterite, but there are many well-known ones which may have thrown the gold out of solution.

Where the sources of the gold were in the mineralised masses of acidic rocks similar actions of solution and re-deposition to those which affected the gold of the basic rocks caused the concentration of the metal in their residuary products.

In many of the gold-bearing districts of British Guiana placers are situated at considerable elevations on the hillsides. In these the laterites are in, or are very near to, their position of formation, and the only processes of concentration that could have acted on them are the chemical ones of solution and re-deposition, and the mechanical ones of the sinking of the quartz gravel, the gold and the heavier resistant minerals through the laterite when saturated with water. The heavier minerals consist mainly of iron-ores, and I have shown that these are, in places, markedly auriferous.

The variations in the proportions of gold contained in the basic rocks give rise to similar variations in the amounts of the metal found in the laterites and the concretionary ironstones. Some deposits of laterite *in situ* are almost barren, whilst others are rich in gold. This is also the case with the concretionary ironstones, many of which are barren, whilst others contain half an ounce, or occasionally more, of gold to the ton. Where auriferous mineralised masses occur on the hillsides or in the valleys their decomposition-products will naturally be richer or poorer in gold according to the relative proportions of the metal the masses contained.

The gradual destruction by sub-ærial detrition of the laterites on the slopes of the hills has set free the quartz gravel, the finely divided gold and the concretionary ironstones, and these, together with a good deal of the laterite, have gradually travelled to the ravines on the hillsides and to the lower parts of the valleys. The action of running water in the ravines and valleys has gradually worn away the relatively soft concretionary ironstones, and liberated the gold contained in them, the metal accumulating in a very finely divided form in the resultant valley gravels, where, in places, by subsequent solution and re-deposition, it has become aggregated into coarser particles and into nuggets of very varying sizes.

In certain districts fissure veins of quartz occur, which are more or less auriferous, whilst, in places, great masses of auriferous quartz are found, generally in hornblendic or chloritic schists. As these were exposed by denudation they gave rise, by detritive processes, to placer gravels, some of which are very rich in gold. But this mode of formation of auriferous gravels is of very subordinate importance to that of their derivation directly from the country rock in British Guiana; and, in my opinion, not 10 per cent. of the placer gravels in the parts of the colony I have visited have originated from quartz reefs and masses.

In leaving the subject of the auriferous districts in British Guiana and their deposits I cannot do better than quote Mr. Braddon's opinion on them as given in the *Mining Journal*:—

"The Guiana alluvial gold fields are possibly the richest existing to-day. . . . These goldfields are, further, amongst the most extensive of the world. The payable fields already proved cover upwards of one thousand square miles, whilst a great part of the Colony still remains unprospected. The volume of worked ground, which can all be profitably re-worked by properly devised hydraulicking, is unimportant in relation to that which remains untouched, even on the established fields.

"The gold-bearing so-called alluvia of Guiana have one very important and special characteristic: they are not confined to the true alluvial drifts of rivers and creeks, as in most countries, but embrace a very great extent of enriched surface and payable decomposed country rock.

"The possibilities of discovering valuable lode forms of deposits in the process of hydraulicking off the surface residual matters are very real and attractive. There are many other special natural advantages for mining in Guiana against few natural disabilities. The Colony has the elements for a very large development of hydraulic mining and dredging, which should directly lead to the discovery and be accompanied by the opening of valuable lode, or lode forms, of deposits. For the successful prosecution of such operations moderate capitalisations are wanted, with intelligent, experienced honest and practical direction, towards definite, clearly perceived, well-chosen, and steadfastly followed purposes.

"The circumstances are in every way favourable for the activities of private enterprise from outside."

CHAPTER XXVI.

THE DIAMANTIFEROUS AREAS.

The first diamond of the discovery of which there are authentic records, was found in 1887 or 1888 in the Puruni River District, but the late Mr. Abraham showed me in 1890 a diamond of about two carats weight which had been given to him many years before by a prospector.

In 1890 Mr. Kaufmann brought to the Government Laboratory a small parcel of stones, the majority of which were diamonds, the rest being white corundums, spinels and quartz. These stones had been found by a prospector in Kaufmann's employ named Gilkes.

Messrs. Kaufmann and Gilkes persevered with their search for diamonds in the years 1890 and 1891, and obtained several hundreds of the stones. But the great distance from the coast of San-San-Kopai, the landing-place for the workings on the Putareng Creek of the Mazaruni, and the attendant expense, stood in the way of the prosecution of the enterprise, with the result that the exploitation of the diamantiferous district was neglected for some years.

Attention having thus been drawn to the occurrence of diamonds in the colony gold-diggers in many parts of the goldfields examined their pay-dirt for them, and from time to time with success. Diamonds were found in small numbers at the Barnard Placers in Upper Mazaruni, in placers in the Puruni District, in the Jimbo Creek District on the Barima River, in the Ianna District of the Barama River, in the Cuyuni District, at Omai on the Essequibo, at Quintette and other placers in the Potaro-Konawaruk District, near the Kuribrong River, and near the Akaiwanna Trail from the Essequibo to the Demerara River. The stones are therefore spread widely and in various districts in the colony.

Mr. Gilkes succeeded in re-arousing interest in the Putareng deposits in 1899-1900, and since then much attention has been given to the exploitation of the diamantiferous areas on the Mazaruni River, whilst some efforts have been devoted to the diamantiferous deposits on the Kuribrong River and in the Potaro Goldfields. The geology of the Putareng District was described in the report by Perkins and myself on the "Geology of the Mazaruni and Puruni Rivers," issued in 1900. Mr. E. G. Braddon, in his paper on "British Guiana and its Mining Development," gave an excellent account of the district and of its workings at the period of the publication of his account, from which many details of the following account are taken.

The belt of diamond-bearing deposits in the Putareng District runs for about twenty miles, approximately parallel to its left bank, at a distance of about five miles from the Mazaruni River, its width being about three miles. The diamantiferous beds are gravels situated at a level of about seventy feet above the Mazaruni River, and lie on the summits and the sides of low hills and stretches of rolling country. They appear to be in the position of their deposition, and they have been derived, in part at any rate, from the degradation of the sandstone and conglomerate formation, outliers of which occur in the neighbourhood. Diamonds are found in the lower layers of these gravels, and also in places in gravels in the valleys which have been eroded through the bedded gravels into the more or less decomposed residua of the granitic and basic rocks which underlie the sandstone and conglomerate formation in this part of the country. The valley gravels are more angular in character than are the bedded ones, much of the quartz they contain having been directly derived from the decomposed, igneous rocks.

The characters of the gravel beds on the hills are as follows: The surface layers, as they do in many other parts of the interior of the colony, consist of, in places, almost pure white quartz-sand, and in others of a similar sand more or less stained by the presence of oxide of iron. These surface layers extend to about eighteen inches in depth, and rest upon a varying depth of a yellowish sandy clay, which contains small angular fragments of quartz, and here and there small patches of sand and gravel cemented by oxide of iron. The sandy clays are of varying depths, from eight to fifteen feet, and in their deeper parts gradually become more gravelly; the pebbles also are there more rounded and larger in size, whilst the pieces of cemented material are more abundant. The diamonds are irregularly distributed through this lower deposit, a very few small-sized ones occurring in its upper parts, whilst they are found more abundantly and of larger size as the workings gradually pass through the lower parts of the gravelly clays to the layers of diamantiferous gravel which rest on the bedrock. Mr. Braddon gives two sections of the gravels, in one of which is shown six feet six inches of barren sand and gravel resting on fifteen inches of gravel and grit and four feet of fine sand. The latter strata contained a few small diamonds. Below them three feet of grey-coloured gravel and sands are shown, which yielded a fair number of diamonds, and rested upon four feet of red-coloured compacted gravel, which contained a relatively large number of the gems. Under the gravels, as bedrock, an absolutely barren kaolin or a red-coloured laterite occurs. The upper layers in these sections undoubtedly owe their grey tinges to the leaching-out of the ferruginous constituents by water charged with organic acids percolating from the humus-bearing topmost stratum. The other section shows a covering of one foot of humus-bearing loam, underlain by three feet of sand and gravel not showing signs of bedding, which rest on a like thickness of grey-coloured bedded sand and gravel. This lies on four feet six inches of red, grey and white grits, sands and gravels, which are underlain by one foot of white and red clayey diamantiferous gravel. The gravel rests on a barren laterite.

The valley deposits are not as thick, as a rule, as are the hill-side formations. They have an overburden of sandy clay up to four feet in thickness, which lies on re-arranged gravel seldom more than four feet in thickness. The bedrock is in places a reddish laterite, in others a greyish kaolin.

The great bulk of both the hill and the stream gravels consists of quartz pebbles, with some of more or less silicified felsite and a few of concretionary ironstone. The heavy minerals, in addition to diamonds, which are found in small pieces in the gravels, are ilmenite, schorl, pleonaste, colourless to faintly coloured corundum and spinel, and occasionally topaz. Minute crystals of zircon are present in small quantities in the sands and in the greyish kaolin of the bedrock. With the exceptions of the schorl and the very sparsely occurring topaz these minerals are found in the basic rocks of the district, and may have been derived from the erosion of the laterites resulting from their decomposition. These, as well as the fragments of schorl and of topaz, are all waterworn and rounded.

The mode of occurrence of diamonds in this district offers no indications as to their original source, and it is perhaps in our present state of knowledge safest to regard them as having been derived from the disintegration of the conglomerate beds which formerly covered the country.

At the same time there is nothing in their mode of occurrence which renders unlikely their derivation, with certain of their accompanying minerals, from laterites resulting from the decomposition of basic rocks.

The diamonds found some years ago at Omai were in a bluish-grey clay, a product of the decomposition of gabbro or diabase *in situ*. The majority of these diamonds were of very small size, running from fifty to sixty to the carat; they were generally very perfect octahedral crystals; and whilst most of them were colourless some were red, some pink, others green, and a good many yellow or orange. I could not obtain at Omai any evidence to connect their occurrences with the sandstone and conglomerate formation.

Those found near the Kuribrong were associated with sericitic and chloritic rocks, which may be metamorphosed sediments; but as the diamonds are there found not far from the escarpment of the sandstone and conglomerate formation, they may have had a similar origin to that suggested for those found in the Putareng District. Similarly those obtained from the placers in the Potaro Goldfield may have come from the breaking up of the sandstone and conglomerate formation, great boulders of which are found near the workings of the Inflexible Syndicate.

CHAPTER XXVII.

THE SOILS OF THE AURIFEROUS DISTRICTS.

Many examinations and analyses have been made of the soils which occur in various parts of the goldfields and of the districts traversed in journeying to them. The soils found belong to two great groups—the first consisting of bed-rock or sedimentary soils which have been formed *in situ* by the gradual decomposition of the underlying igneous rocks; the second the alluvial, æolian, transported, or drift-soils, including carbonaceous soils formed largely by the growth of plants.

Amongst the former group are very widely distributed soils which have been produced by the decomposition and degradation of granitic and gneissose rocks, of quartz-porphyries and allied rocks, of chloritic rocks, and of the basic rocks such as mica-gabbro, epidiorite, hornblende-schist, and diabase. Several specimens of each of these soils were collected and examined.

Of the soils of the second class attention has been directed towards the so-called "pegass" soils which consist largely of tropical peat; the æolian soils on the sand-dunes which form a conspicuous feature in places in the country between the goldfields and the coast; and the alluvial or fluviatile soils found on the flats of some of the larger creeks.

Soils formed in situ—*Bed rock Soils.*—In some places the soils derived from the acidic rocks, more especially from the granites and gneisses, have undergone more or less extensive re-arrangement, with the result that two classes of soils have been formed—arenaceous, or sandy soils, and argillaceous or clayey soils. In the parts of the colony examined the quartz-porphyries and their allied rocks usually form relatively low-lying ground, and the soils derived from them have, as a rule, undergone little re-arrangement.

The mean compositions of the soils derived from the acidic group of rocks were found to be as follows:—

	Soils from Granite and Gneiss.		*Soils from Quartz-Porphyry and allied Rocks.*
	Arenaceous.	Argillaceous.	
Stones removed before analysis ...	4·2	nil.	4·6
Water retained by air-dried soil ...	4·7	2·2	2·9

COMPOSITIONS OF THE DRIED FINE SOILS.

	Soils from Granite and Gneiss.		*Soils from Quartz-Porphyry and allied Rocks.*
	Arenaceous.	Argillaceous.	
[1] Humus	1·915	·805	1·478
[2] Root residues, and combined water	3·617	7·302	4·261
Quartz sand	65·318	20·634	32·687
Clay and insoluble silicates	19·806	57·605	55·385
Iron peroxide	1·713	2·601	2·111
Alumina	7·180	10·755	3·564
Manganese oxide	·030	·001	nil.
Calcium oxide	·087	·066	·107
Magnesium oxide	·073	·088	·082
[3] Potassium oxide	·056	·123	·082
Sodium oxide	·165	·146	·136
Sulphuric anhydride	·006	·008	·010
[4] Phosphoric anhydride	·004	·011	·005
	99·970	100·145	99·908
[1] Contains nitrogen	·038	·063	·060
[2] Contains nitrogen	·061	·076	·054
Total nitrogen	·099	·139	·114
[3] Soluble in 1 per cent. citric acid ...	·005	·006	·003
[4] Soluble in 1 per cent. citric acid ...	·0015	·0035	·002

The arenaceous granitic soils are dark-grey and sandy, are very deficient in their retentive power for water, and whilst they might yield, in favourable seasons, small crops of various kinds, such as cassava, sweet potato, etc., from plants which prefer arenaceous soils, during dry seasons these crops would fail. Any attempt at permanent cultivation upon the arenaceous soils must prove futile.

The compositions of the argillaceous soils are more promising than are those of the arenaceous ones for permanent cultivations. Like the latter, the crops on them will be liable to suffer from drought, owing to their low retentive power for water. Their contents of nitrogen and potash are sufficient for many permanent products, and fair crops of the usual so-called ground provisions and of upland rice could be readily raised on them. Probably these soils, after a few crops had been raised on them, would require the addition of calcareous and of phosphatic manures to enable them to yield satisfactory returns.

The soils derived from quartz-porphyry and allied rocks are of somewhat lighter texture than are the argillaceous granitic soils, and on the whole, from their texture, are better suited for permanent crops. They are probably well adapted for the cultivation of rubber-bearing trees and similar products.

The argillaceous granitic soils, and those last described, are either grey or cream-coloured soils. They occur over vast areas, in the valleys in granitic and gneissose country, and as wide-spread coverings to the more or less unaltered rocks in districts where the country is quartz-porphyry or felsite. The main difficulty in the successful cultivation of these classes of soils is the retention of their fertility and increase in their powers of retaining water. This can only be done by careful tillage, in which every care is directed to the conservation of their contents of humus.

The basic rocks, which occur extensively in the gold-bearing districts, upon decomposition give rise to ochreous and to red and deep-red coloured soils, the topmost layers of which are not unfrequently more or less bleached by the action of percolating waters charged with organic acids arising from the decaying vegetable matters of the forests. They usually contain considerable proportions of ironstone gravel, in fact in some places the proportions of ironstone gravel is so high as to render them more or less unproductive or practically useless for purposes of cultivation. Their mean compositions are given in the following table :—

	Sedentary Soils from			
	Gabbro.	Epidiorite, etc.	Diabase.	Chloritic Rocks.
Stones removed before analysis ...	33·8	29·4	27·1	6·8
Water retained by air-dried soil	2·8	8·0	5·0	5·7

COMPOSITIONS OF THE DRIED FINE SOILS.

	Gabbro.	Epidiorite, etc.	Diabase.	Chloritic Rocks.
[1] Humus	·878	·947	·612	·225
[2] Root residues, and combined water...	11·818	14·302	9·607	7·218
Quartz-sand	31·818	5·709	27·174	42·586
Clay and insoluble silicates ...	20·012	31·560	32·238	25·967
Iron peroxide	15·159	17·631	14·096	13·762
Alumina	19·701	29·137	15·577	9·575
Manganese oxide...	·051	·132	·027	·179
Calcium oxide	·207	·068	·117	·144
Magnesium oxide	·139	·108	·119	·161
[3] Potassium oxide	·063	·085	·055	·029
Sodium oxide	·099	·069	·119	·111
Sulphuric anhydride	Nil	Nil	·012	Nil
[4] Phosphoric anhydride	·030	·021	·046	·032
	99·998	92·769	99·799	99·989

COMPOSITIONS OF THE DRIED FINE SOILS—*continued.*

	Gabbro.	Epidiorite, etc.	Diabase.	Chloritic rocks.
[1] Contains nitrogen	·098	·058	·042	·069
[2] Contains nitrogen	·048	·062	·060	·037
Total nitrogen	·146	·120	·102	·106
[3] Soluble in 1 per cent. citric acid solution	·007	·003	·012	·004
[4] Soluble in 1 per cent. citric acid solution	·0006	·001	·002	·0002

The soils which have been derived from the basic rocks differ from those formed from the granitic and gneissose rocks by the very high proportions of iron peroxide and alumina they contain. Their physical textures are very well adapted for cultivation. Whilst they contain fair proportions of nitrogen their contents of potash and phosphoric acid are somewhat low. They are more readily cultivated than are the soils from the acidic rocks, and their higher retentive powers for water render them far less likely to be adversely affected by drought. But it is necessary when planting on these soils not to entirely remove the forest vegetation with which they are naturally covered, as their texture renders them, when exposed, very subject to losses by rainwash. Hills and hill sides covered with these soils, if exposed to the tropical rains without any protective vegetable covering, are in a comparatively short time converted into barren areas of ironstone gravel by rainwash.

The aboriginal Indians usually select the soils derived from the basic rocks for their fields, leaving those from the acidic rocks to their natural destination of supports for forest trees. But the Indians seldom, if ever, cultivate their fields for longer than two or three years in succession; they then either totally abandon them, or, after leaving them to rest for several years, during which the land rapidly becomes covered with low scrub, again clear them and obtain one or more crops. Their mode of agriculture on these soils is to clear the area which they intend to plant, felling the trees and burning the brushwood, etc. They distribute the ashes thus obtained over the land in little heaps, and in or near these heaps they plant cassava-sticks, banana suckers, sweet potatoes, yams, sugar-cane, maize, etc. During the first season these yield satisfactory crops. After the first crops have been reaped the Indians again fertilise the land with the ashes of such brushwood as they are able to readily and easily obtain, but as in the second and succeeding years ashes will not be available in anything like the quantity they were the first year the later crops fall off in quantity, whilst after two or three crops there is seldom brushwood, etc., left unburnt to supply sufficient of the ash constituents for further crops.

Alluvial, Æolian and Carbonaceous Soils.—Drift-soils.—The following table gives the mean compositions of some fluviatile alluvial soils, of some of the æolian soils of the sand dunes, and of some of the pegass or peaty soils:—

ALLUVIAL, ÆOLIAN AND CARBONACEOUS SOILS.

—	*Alluvial.*	*Æolian.*	*Carbonaceous.*
	Fluviatile Soils.	Sand Dune Soils	Pegass or Peaty Soils.
Stones removed before analysis ...	—	—	—
Water retained by air-dried soils ...	3·5	·3	10·7

COMPOSITIONS OF THE FINE DRY SOILS.

	Alluvial.	*Æolian.*	*Carbonaceous.*
	Fluviatile Soils.	Sand Dune Soils.	Pegass or Peaty Soils.
[1] Humus	·419	·194	36·003
[2] Root-residues, and combined water	10·386	·366	25·238
Quartz sand	33·763	97·313	4·288
Clay and insoluble silicates ...	34·899	1·746	23·962
Iron peroxide	8·517	·178	2·952
Alumina	10·837	·015	5·856
Manganese oxide	·112	—	—
Calcium oxide	·397	·024	·319
Magnesium oxide	·184	·083	·493
[3] Potassium oxide	·152	·018	·379
Sodium oxide	·274	·058	·176
Sulphuric anhydride	·008	—	·182
[4] Phosphoric anhydride	·054	·003	·056
	100·002	99·998	99·904
[1] Contains nitrogen	·077	·017	·344
[2] Contains nitrogen	·138	·019	·925
Total nitrogen	·215	·036	1·269
[3] Soluble in 1 per cent. citric acid solution	·004	003	·021
[4] Soluble in 1 per cent. citric acid solution	·004	·0012	·009

The fluviatile alluvial soils are frequently very fertile, and are usually very well suited in texture for agricultural purposes. Their positions in the lower flats of small streams are against their being cultivated to the extent their merits would warrant, as they are subject to flooding, and thus at times to the danger of loss of the crops grown on them. As a general rule they are ochery-yellow, somewhat stiff, soils. They are, as a rule, far more fertile than are the soils which have been produced by the decomposition of the country rocks *in situ*. Some of them, especially those situated near Harimaraka in the Mazaruni River, are of marked potential fertility, and are rich in their contents of nitrogen, potash, lime and phosphoric acid.

The æolian soils are fine, sandy soils utterly unfit for cultivation-purposes. They are deficient in all the elements of plant-food, and where they occur on the upper slopes of the sand dunes support merely a sparse vegetation of stunted bush; whilst on the lower slopes, below the level of the water-table, they are covered with layers from two to four inches in depth of matted vegetable debris and tangled roots, and in many places carry very heavy growths of mora-forest.

In low-lying places in the colony, over very large areas, the land is covered with soils which vary from peat, with nearly 90 per cent. of organic matters, to peaty soils, with from 35 to 45 per cent. of them. The organic matters of these soils are formed by the accumulation and partial decomposition of ferns, sedges, and other plants which flourish on the low-lying swampy lands of Guiana. In their natural state their fertility is very low, as they are loose in texture, so that in wet seasons they become sodden with stagnant water, and in dry seasons form dry spongy layers which have comparatively little retentive power for hygroscopic water. The deep deposits of pegass are practically useless for economic cultivation, but the shallower ones, by deep cultivation, so as to bring up some of the underlying subsoil, usually a greyish to white pipe-clay, are rendered heavier, and if then properly drained, become in a few seasons very fertile, but even after this, crops on them are very liable to fail in periods of either excessive rain or of drought, especially of the latter.

It is evident from the compositions and the physical characters of the soils of the interior of the colony that few of them are of well-marked fertility. But in the neighbourhood of all the placers I have visited there are soils which will repay cultivation if they are utilised for the production of the commoner tropical food-products. Cassava, sweet potatoes, eddoes, yams, sugar-cane, bananas, limes, capsicums, and pineapples are among the products which can be successfully cultivated on many of the lighter soils, whilst plantains, bananas, sugar-cane, maize, sorghum and rice are crops suitable for cultivation on the heavier ones.

Swine and various kinds of poultry do well in many parts of the bush; and where locations over considerable areas are made, it will be in the interest, not alone of the owners, but more especially of their labourers, if considerable areas of land are placed under cultivation, so as to obtain vegetables for the staff and the labourers, and food for live stock.

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PLATE 31.

STEAMER TERMINUS AND RAILWAY STATION AT WISMAR, DEMERARA RIVER.

Photo by H. I. Perkins.

CHAPTER XXVIII.

(C. WILGRESS ANDERSON, F.G.S., F.R.G.S.)

TRANSPORT FACILITIES IN BRITISH GUIANA.

For the purpose of the Mining Regulations the Colony has been divided into five districts, viz.:—

No. 1.—The Courantyne, Berbice and Demerara Rivers.

No. 2.—The Essequibo River and its tributaries south of Bartica.

No. 3.—The Mazaruni River and its tributaries.

No. 4.—The Essequibo River north of Bartica and the Cuyuni River.

No. 5.—The North-Western district through which the Barima, Waini, and Barama Rivers flow.

There is no regular steam communication with the Courantyne River, but it can be reached from Georgetown, or from New Amsterdam, by transient cattle-steamers and by local sailing-craft trading between these ports and the river. The Courantyne is navigable for such craft for over one hundred miles upwards from its mouth, beyond which smaller boats must be used.

New Amsterdam, a town situated on the east bank of the Berbice River, about five miles from its mouth, is in daily communication with Georgetown by railway, and there is a bi-weekly steamer-service between the two towns. From New Amsterdam a steamer leaves twice each week for Kumaka, an old Indian settlement opposite the mouth of the Wironi Creek, about eighty-five miles up the Berbice River; whilst beyond Kumaka the Berbice River is navigable for small boats only.

Georgetown is in daily communication by steamer with Wismar, sixty-five miles up the Demerara River, whence a railway runs to Rockstone on the Essequibo River. From Wismar a steam-launch runs twice each week to Malali, at the foot of the first rapids in the Demerara River.

Shortly after the arrival of the steamer from Georgetown at Wismar, passengers and freight are conveyed to Rockstone by train, a distance of about nineteen miles. From Rockstone, for the journeys up and down the Essequibo and the lower Potaro Rivers to Tumatumari Cataracts, the site of the gold station for the district, there is a service of steam-launches which call at Omai, Kumaka and Potaro Mouth.

These journeys usually each occupy a day, launches leaving every week-day morning from both Rockstone and Tumatumari, but during dry seasons two or more days may be required to perform them. From Tumatumari a launch conveys passengers and freight to Potaro landing, whence the Potaro road runs for nineteen miles through the mining district lying between the Potaro and Konawaruk Rivers. Mules and carts can be hired for transport along this road, which is well laid out and is kept in repair by the colony.

A steamer leaves Georgetown every Tuesday, Thursday, and Saturday for Bartica, a small settlement at the junction of the Essequibo and Mazaruni Rivers, returning to Georgetown on the following Wednesday, Friday, and Monday. From Bartica the upper stretches of the Mazaruni and Cuyuni Rivers can only be reached by boats, each of which must, in accordance with the river navigation regulations, be in the charge of a certificated steersman and bowman, who direct her through the many and sometimes dangerous low cataracts and rapids which impede the navigation of these rivers.

From Bartica a road has been cleared running in a southerly direction between the Mazaruni and Essequibo Rivers for about sixty-seven miles to a large tributary of the Mazaruni River called the Kaburi Creek; it is little used, however, as miners and prospectors prefer the cheaper and easier communication by the river.

The mining-claims between the Cuyuni and Puruni Rivers are situated some distance from their banks, and access to them is by trails or bush-paths which are used as main roads, from which branch off many smaller paths to the various placers. Transport is very difficult along these paths, especially during wet weather. Some of them run inwards from the rivers for distances of over thirty-five miles. A path from Perseverance Landing on the Cuyuni connects that river with the Puruni, and is now largely used as a means of access to some of the claims in the latter river.

The American syndicate working the Peters Mine have re-opened and extended a cart-road made by the colony from Kartabo Point, at the junction of the Cuyuni with the Mazaruni River, towards the Puruni River. It is proposed to connect the Puruni termination of this road with the diamantiferous areas on the Upper Mazaruni River by means of a bush-path.

The Bartica steamer stops opposite the Groete Creek, a large tributary on the west bank of the Essequibo River, about fifteen miles north of Bartica, to land passengers and cargo for the claims that are being worked at the head-streams of this tributary and which are connected with the Cuyuni River by a path emerging on that river near Tiger Island.

The lower reaches of the Cuyuni River are served by launches plying betwen Bartica and the foot of the Kamaria Road, and from the head of that road to Arawak Matope.

The North-Western district is reached by steamer which leaves Georgetown once a week and arrives on the following day at Morawhanna, a small settlement on the Barima, and thence proceeds

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PLATE 32.

POTARO-KONAWARUK ROAD, POTARO DISTRICT.

Photo by H. I. Perkins.

to Mount Everard, about fifty miles up the river. Beyond Mount Everard a launch runs to Arakaka when there is sufficient water in the river, or as far as Koriabo only when the river is low. The upper parts of the Barima River beyond the Eclipse Falls are only accessible by boat.

Arakaka is a small settlement consisting of a police-station, a gold-station, a hospital, a hotel and some shops, from which a road runs across to the Towakaima Falls on the Barama River, a distance of twenty-nine miles, with a branch line to Mazawini situated lower down the Barama River, where there is a gold station and a shop.

From Morawhanna two small launches run to Mazawini when there is sufficient water in the Barama River to allow them to do so, but when the water in that river is low they can only go as far as the mouth of the Hoori Creek, where there is a landing, whence a path leads to near the head of that tributary. Under these conditions of the Barama River many of the miners in the district are compelled to obtain their supplies from Arakaka by means of the Barima-Barama Road.

There is an alternative route to the gold-fields of the North-Western district. A steamer leaves Georgetown each week-day morning and proceeds to Suddie. From that place there is a good road to Anna Regina, whence a canal or waterpath leads to the Tapacooma Lake. On the southern side of the lake there is a portage by which boats obtain access to the Tapakuma Creek, which flows into the Pomeroon River near Pickersgill. From this place the journey is, for a distance of about thirty miles, down the Pomeroon River to its mouth. A voyage of from two to three hours across the bay into which the Pomeroon discharges its waters leads to the mouth of the Moruka River. Some hours' boat journey up this river leads to the itabo or waterpath which connects the upper waters of the Moruka with those of the Bara-bara, which leads into the Barramanni, a tributary of the Waini River, which joins it at Barramanni, whence a journey may be made up either the Barama or the Barima Rivers, as already described.

CHAPTER XXIX.

(F. FOWLER.)

HINTS TO MINERS AND PROSPECTORS.

Miners and prospectors should, on arrival in the colony, before selecting a district in which to prospect, visit the Department of Lands and Mines, and examine the charts of the various districts which can be seen and purchased there. It will be necessary there to obtain a prospecting license, which is issued for 1*s*. The Government Laboratory should next be visited, where an extensive collection of specimens of the various rock-formations in the different districts in which gold and diamonds have been and are now being found can be examined.

A copy of the laws and regulations relating to mining should be obtained from one of the stationery establishments in Georgetown, and should be carefully studied.

Having decided on a district in which to commence operations it becomes necessary to make arrangements for stores and other equipment required for the expedition. Valuable assistance in this very important matter can be obtained from the Institute of Mines and Forests, where all the labourers required for the goldfields must be registered, and where contracts as to their terms of engagement, etc., can be drawn up and entered into. The Institute will obtain the labourers required, advance them money for their journey, and see that they leave Georgetown on the day appointed for their departure.

The labourers available are chiefly black men, natives of the colony, of Dutch and of French Guiana, and of the West Indian Islands, interspersed with some East Indians. They are generally engaged for a term of from three to four months, and are paid wages of from 1*s*. 8*d*. to 2*s*. 8*d*. per day, and it costs, in addition, about 1*s*. per day each for their rations.

There are a number of men in the goldfields who can be engaged as labourers on the spot; and as there are registration offices of the Institute of Mines and Forests in each district, they can be there registered.

Boats can be hired at Bartica, Rockstone and Arakaka. The charge for a boat with its tackling, paddles, ropes, tarpaulins, buckets, bailers, etc., is from 5*s*. to 8*s*. per day according to the size of the boat. If a large amount of prospecting work is contemplated it will be found

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PLATE 33.

TRAVELLING CAMP ON THE ESSEQUIBO RIVER.

Photo by C. W. Anderson.

much cheaper to purchase a boat for from £25 to £35, capable of carrying from three to four tons of cargo. A boat of these dimensions will require a crew of from twelve to sixteen men to propel her. The labourers engaged for the expedition will form part of this crew, but it is essential to employ five or six trained boat hands who are experienced in river work.

The steersman and the bowman of the boat are paid at the rate of from £7 to £8 and of from £5 to £6 respectively per month, whilst the boat hands are paid at the rate of 2*s* per day. All members of the boat's crew have to be fed by the expedition.

The best packages for carrying and keeping clothes are iron or steel trunks, termed locally "cannisters," and these can be obtained at any of the stores in Georgetown at cheap rates. Leather trunks and bags are useless, for they are soon affected by the damp and fall to pieces, and are also very subject to destruction by ants.

Woollen clothing, both outer and under, is the best for wear, as when the body is warmly clad a person is less liable to chills, with their concomitant result—fever. The stores in Georgetown offer a large selection of such clothing.

A cotton hammock is necessary for sleeping in, and one can be bought for from 20*s*. to 25*s*., whilst a good warm blanket should also be used, as it is a wise precaution to keep a warm and even temperature round the body during the nights and the early mornings, which often feel very chilly. A properly constructed mosquito netting for use with the hammock is essential if the traveller is desirous of avoiding any chance of contracting malarial fever.

Soft felt hats are the most comfortable head-gear for wear in the interior and strong yet light shooting-boots are best for protecting the feet. A strong cotton umbrella will be found serviceable.

Whilst travelling, and until a working camp has been established and regular work started, the only food available will consist of tinned or canned meat and fish, salt beef, pork and fish, bread or biscuits, and vegetables, although birds and animals may be shot, or fish caught now and then to vary the somewhat monotonous rounds of these foods. After a permanent camp has been established poultry can be raised, as they thrive well in the bush, and several kinds of tropical vegetables, such as cassava, eddoes, yams, sweet potatoes, plantains, etc., can be grown. Lime trees and many varieties of capsicums grow very well indeed in the interior of the colony, and their fruits form very welcome additions to the dietary of the camp. An Indian huntsman should be employed to obtain supplies of fresh meat and game from the animals and birds which are found in the forest.

Accommodation can be obtained at hotels in Bartica, Rockstone, Mt. Everard and Arakaka; but beyond these places, in travelling up and down the rivers, a camp has to be made each night by spreading a large waterproof sheet or tarpaulin, under which the hammocks are slung to poles driven into the ground. The boat-hands are usually very expert at selecting sites for and erecting these camps. They make them easily and quickly; and the camps are very comfortable when it has proved possible to obtain a favourable site. It is advisable while travelling to camp not later than 4.30 p.m., so that dinner can be cooked and eaten before the night falls, as the men require to get to sleep early after their hard day's paddling. An early start should be made in the morning to take advantage of its relatively low temperature and of the shade near the banks of the rivers before the sun rises above the tops of the forest trees which border them.

Certain medicines have been officially prescribed, and must be carried by each expedition. Wherever possible these should be in tabloid form.

APPENDIX A.

THE MINING ORDINANCE,
No. 1 OF 1903.

AN ORDINANCE TO MAKE PROVISION FOR MINING FOR GOLD, SILVER, AND VALUABLE MINERALS, AND FOR PRECIOUS STONES.

THE MINING ORDINANCE, 1903.

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BRITISH GUIANA.

[COURT OF POLICY.]

ORDINANCE No. 1 OF 1903.

An Ordinance to make provision for Mining for Gold, Silver, and Valuable Minerals, and for Precious Stones. [7th February, 1903.]

BE it enacted by the Governor of British Guiana, with the advice and consent of the Court of Policy thereof, as follows :— A.D. 1903.

1. This Ordinance may be cited as "The Mining Ordinance, 1903." Short Title.

2. In this Ordinance and in any Regulations made thereunder, unless the context otherwise requires— Definitions.

"Commissioner" means the Commissioner of Lands and Mines, or in the absence of the Commissioner, the officer of the Department next in rank.

"Officer" means and includes every Justice of the Peace, every Commissary of Taxation, every Customs Officer, every Officer of the Department of Lands and Mines, every Warden and Sub-Warden, all Police and other Constables, all Officers specially appointed for the purposes of this Ordinance, and every other public officer appointed by the Governor by notice in the Gazette. (3 of 1887, s. 2.)

"Warden" means any Officer appointed by the Governor for the purposes of this Ordinance and of the Mining Regulations for the time being in force to be Warden of a Mining District, and unless the context otherwise requires includes Sub-Warden.

"Mining Regulations" means the Regulations in the First Schedule to this Ordinance, and any Regulations made under the authority of Section 82 of this Ordinance.

"Mining District" means any portion of the Colony declared to be a Mining District under Section 4 of this Ordinance.

"Raw Gold" includes any substance or thing containing gold or of which gold forms a part, whether it has been smelted or not, upon which the payment of Royalty is not admitted by the Commissioner. (3 of 1887, s. 2.)

"Precious Stones" means rough or uncut precious stones only.

"Valuable Minerals" means any mineral containing gold or silver or both, together with some other metal in such proportions that the gold or silver or both combined obtainable from such mineral is or was of greater value than the cost of separating the gold or silver or both from the baser constituents, without any expenditure for rendering these latter constituents of commercial value. (3 of 1901, s. 3.)

"Concession" means any permission, exclusive right, concession, or grant in respect of any portion of Crown Lands of the Colony, under Part II. of this Ordinance.

"Licence" and "Claim Licence" mean any licence to occupy any portion of the Crown Lands of the Colony for the purpose of Mining, issued under Part III. of this Ordinance.

"Precious Stones Licence" means a licence for the purpose of mining for precious stones only.

"Claim" means the area of Crown Land in respect of which a concession is granted or a licence is issued, and includes any claim located whether a concession or licence has been issued in respect thereof or not, and includes the area of any land or water, in respect of which a dredging concession is granted.

"Person" includes any company, corporation, society, syndicate, or other body of persons, whether corporate or unincorporate.

"Servant" means any person who has entered into and is subject to a contract of service to be performed on or in respect of any claim, and includes a registered labourer. (15 of 1896, s. 13, ss. 5.)

Part I.—Administration.

Charge of minerals and precious stones on Crown Lands.

3. The Commissioner shall have the charge of and act as guardian over all minerals, including gold and silver and valuable minerals, and precious stones within the lands, rivers and creeks of the Colony.

Power to declare Mining Districts, and to establish stations.

4. The Governor may by notice to be published in the Gazette and one other newspaper circulating in the Colony, declare any portions of the Colony to be Mining Districts, and establish one or more stations in or in the neighbourhood of any Mining District, and by a like notice direct that all persons going to or coming from a Mining District shall stop and report themselves at one or more specified station or stations to the respective officers in charge thereof, and be examined and searched. (3 of 1887, s. 19.)

Appointment and duties of Wardens.

5.—(1) The Governor may appoint for each Mining District an officer to be called a Warden.

(2) Each Warden shall be responsible for the efficient working within his Mining District of this Ordinance and of any Regulations made under it and for the time being in force.

(3) The Governor may at any time transfer a Warden from one Mining District to another.

Appointment of Sub-Warden.

6. The Governor may appoint for each Mining District one or more Assistants to the Warden. Such Assistants shall be called a Sub-Warden.

7. The Governor may appoint such other officers, including female searchers, for the purpose of this Ordinance as he may consider necessary, and such officers shall respectively have and exercise such powers and discharge such duties as may be assigned to them by this Ordinance or by any Regulations made thereunder. (3 of 1887, s. 20.) Appointment of Officers.

8. All Wardens and Officers in the performance of their duties under this Ordinance and under the Regulations shall act under the directions of the Commissioner, and will be held responsible through him to the Governor. Control of Wardens and Officers.

9. The Governor may by Order-in-Council confer on any Warden but not on a Sub-Warden the jurisdiction and powers and require him to discharge the duties of a Magistrate within his Mining District, and due notice thereof shall be published in the Gazette. (15 of 1896, s. 19.) Power to confer magisterial powers on Government Officers.

10. If the Mining District of any Warden or any part thereof forms part of the Judicial District of any Magistrate, any order of the Governor under the preceding section shall not affect the jurisdiction or powers of the Magistrate. (15 of 1896, s. 18.) Effect on Stipendiary Magistrate's jurisdiction.

11. The Commissioner may exercise any of the powers or discharge any of the duties by this Ordinance or any Regulations made thereunder, conferred or imposed upon any Warden or other officer of the Department of Lands and Mines save and except the powers and duties conferred and imposed by section 9 of this Ordinance. Powers of the Commissioner.

12. A Warden may at any time enter on and inspect any claim and any building or work connected therewith. Power of Officer to inspect claim.

Part II.—Concessions.

13. The Governor may with the approval of the Secretary of State grant a general concession to any person, entitling such person to the soil and to gold, silver and valuable minerals, and precious stones found therein. (3 of 1901, s. 9.) General concession.

14.—(1) In any case in which owing to the amount of capital to be invested or the works to be undertaken by any person who desires to obtain a concession, it appears expedient to the Governor-in-Council to do so, the Governor-in-Council may with the approval of the Secretary of State permit such person to temporarily occupy and explore, for the purpose of testing the value of, unoccupied Crown Lands without a concession in respect thereof being first granted, subject nevertheless to such terms and conditions as to the Governor-in-Council may seem meet. Permission to explore.

(2) The Governor-in-Council may, in special cases and with the approval of the Secretary of State, give to any person the exclusive right to occupy and explore, as provided in sub-section (1) hereof, within a given area. (3 of 1901, s. 4.)* Exclusive right to explore.

15. The Governor-in-Council may grant, on such terms and conditions as he shall deem meet, a concession authorizing any person therein named to occupy any portion of the Crown Lands of the Governor-in-Council may grant mining concessions.

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* Note.—For terms and conditions see Appendix B.

Colony, and, subject to the provisions of this Ordinance, and any Regulations made thereunder therein to mine for and when found to take and appropriate*

i. gold, silver, and valuable minerals : or
ii. precious stones : or
iii. gold, silver and valuable minerals, and also precious stones. (3 of 1887, s. 3, amended.)

Concession to be exclusive.

16. It shall not be lawful to grant concessions to different persons in respect of the same area of Crown Lands.

Proviso.

Provided that in the case of any area the concession in respect of which has been cancelled or has for any reason ceased to be in operation, a fresh concession may be granted.

Dredging concession.

17.—The Governor-in-Council may grant on such terms and conditions as he shall deem meet, a concession to any person to occupy any river or creek or portion thereof and there to dredge for and, when found, to take and appropriate all gold, silver and valuable minerals, and precious stones ;

Provided that every such concession shall be subject to such regulation as may, from time to time, be made by the Governor and Court of Policy. (3 of 1901, s. 8.)

Grants of Crown Lands to which concessions relate.

18. In any case in which a concession is granted in respect of unoccupied Crown Lands, the Governor may make an absolute grant therewith of the Crown Lands in respect of which such concession was granted without requiring the provisions of the Crown Lands Ordinance, and the Crown Lands Regulations for the time being in force, to be complied with : Provided that no grant of the nature set forth in this section shall be made either under this section or in any other way without the approval of the Secretary of State. (3 of 1901, s. 5.)

Limit of area to be granted by concession.

19. No concession shall be granted to any person for any larger area than five hundred acres, except with the approval of the Secretary of State. (3 of 1887, s. 3 (1).)

Reservation of right to grant waterways, etc.

20. Nothing in any concession shall be construed to prevent the Governor from granting to any person not mentioned in the concession the right to lead or convey water, or to make or construct waterways, through or over, or to construct reservoirs on, or to take water from the land specified in the concession. (3 of 1887, s. 3 (4).)

Right to cut timber and fuel.

21. The holder of every concession may, subject to the Mining Regulations and the Crown Lands Regulations for the time being in force, cut timber and fuel on the Crown Lands for mining purposes, on payment of the royalty prescribed by the Crown Lands Regulations. (3 of 1887, s. 4.)

Payment of Royalty.

22. The holder of every concession shall pay on the value of all gold, silver, and valuable minerals and precious stones found and appropriated within the area of his concession, such royalty as the Governor and Court of Policy may by Regulations under this Ordinance from time to time determine. (3 of 1887, s. 3 (8).)

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* Note.—For terms and conditions see Appendix C.

23. Nothing in any concession shall be construed to prevent the Governor from at any time directing that any portion of the land in respect of which it is granted shall be taken and used for public purposes, and when the Governor so directs the land specified in the order of the Governor shall be taken and used for public purposes, without giving any right to compensation therefor. (3 of 1887, s. 3 (6).)

Land required for public purposes may be withdrawn from a concession.

24. Every concession shall be subject to the Mining Regulations. (3 of 1887, s. 3 (7))

Concession subject to Regulations.

25. It shall be lawful for the Governor-in-Council to cancel any concession issued under the provisions of this part of this Ordinance,

Cancellation of concessions.

(1) In case of persistent refusal or neglect to carry out the Mining Regulations.
(2) On breach of any condition on which the concession was granted, or which is included in the terms of the concession.
(3) In case it shall be certified to the Governor by any officer appointed to visit the claim specified in the concession or to report thereon that the person to whom the concession was granted has ceased to carry on the work, or to pursue the purpose for which the concession was granted. Provided that no concession shall be cancelled until the holder of the concession has had an opportunity of being heard either personally or by counsel and showing cause against such cancellation before the Governor-in-Council.

26. Notwithstanding anything hereinbefore contained, it shall be lawful for the Governor-in-Council to grant any concession upon the terms that no royalty shall be paid in respect of any gold, silver, valuable mineral or precious stones obtained under such concession, if due provision, to the satisfaction of the Governor-in-Council is made in such concession for the payment of any sum or sums of money or other consideration, in lieu of such royalty.

Power to grant concession without payment of royalty.

27.—(1) Before a concession is granted notice of the intention to grant such concession shall be published on three successive Saturdays in the Gazette and any person desiring to object to the grant of such concession may do so, by petition addressed to the Governor-in-Council and may if the Governor so orders be heard in person or by counsel in opposition.

(2) The Governor may, in any case, refuse to grant a concession.

Governor may refuse to grant concession.

Part III.—Licences.

28. The Commissioner may, with the approval of the Governor, issue a licence authorizing any person therein named to occupy any portion of the unoccupied Crown Lands of the Colony and subject to the provisions of this Ordinance and of any Regulations made thereunder to mine for and when found take and appropriate

Issue of licence to mine.

i. gold, silver and valuable minerals : or
ii precious stones : or
iii. gold, silver and valuable minerals, and also precious stones.

29. Any such licence shall be issued in accordance with and subject to any conditions prescribed by the Mining Regulations.

Issue of licence to conform to regulations.

Two licences not to issue within same area.

30. It shall not be lawful to issue in respect of the same area of Crown Lands licences to different persons.

Proviso.

Provided that in the case of any area the licence in respect of which has been cancelled or has for any reason ceased to be in operation, a fresh licence may issue.

Provisions of Ordinance relating to concessions made applicable to claim licence.

31. The provisions of sections 19, 20, 21, 22, and 23 of this Ordinance, respecting concessions, shall also apply to licences issued under this part of this Ordinance.

Right to revoke or withhold licence.

32.—(1) The Governor-in-Council may revoke a licence issued under this Part ; Provided that no licence shall be revoked until the holder of the licence has had an opportunity of being heard either personally or by counsel and showing cause against such revocation, before the Governor-in-Council.

(2) The Governor may order that a licence under this Part shall not be issued.

Property in gold obtained on located claim without permission of claim holder.

33. All gold, silver, valuable minerals or precious stones obtained on a claim without the permission of the owner of the claim, shall be the property of the owner of the claim, provided that he is complying with the Mining Regulations as to the marking of boundaries and has paid the rent payable by him ; but if he is not complying with the said Regulations or has not paid the said rent, it, or they, shall be the property of the Colony.

Part IV.—Mining Licences on Private Lands.

Licences to mine on private lands.

34. The Commissioner may with the approval of the Governor, issue a licence to any person authorizing such person to enter on private lands or lands of the Colony and there search and mine for and when found take and appropriate gold, silver, and valuable minerals or precious stones ; Provided always that every such licence shall be subject to such regulations as may from time to time be made by the Governor and Court of Policy. (3 of 1887, s. 5.)

Right to baser metals on private lands.

35.—(1) The owner of any private lands granted before the passing of this Ordinance shall hold and enjoy all metals other than gold and silver therein or thereon, and may search and mine for and when found, take and appropriate the same to his own use without previously obtaining any licence.

(2) The owner of any private lands as aforesaid shall also be entitled to take and appropriate to his own use any metal other than gold or silver contained in any valuable mineral in or on his lands, and which has been separated from such gold or silver by the holder of any such licence as aforesaid, unless such holder purchases such metal from the owner of the land at such price as may be agreed on, or in default of any such agreement being arrived at as may be stated in writing by the Commissioner to be the net value of the metal after paying the cost of winning the same, no deduction from such cost being made on account of gold or silver or both having been obtained along with such metal.

(3) The owner of any private lands as aforesaid may without previously obtaining any licence search and mine for and when found take and appropriate any mineral therein or thereon containing gold or silver or both together with some other metal in such proportions

that the gold or silver or both combined obtainable from such mineral is or are not of greater value than the cost of obtaining the same alone therefrom ; Provided always that in any such case such owner shall, if any gold or silver or both is or are extracted from such mineral, comply with the Mining Regulations for the time being in force as to keeping a record of gold or silver obtained and as to the removal thereof and the payment of Royalty thereon.

(4) Nothing in this section shall authorize the owner of any private lands to search and mine for or when found to take and appropriate to his own use any valuable mineral in or on his lands without previously obtaining such licence as aforesaid.

(5) Nothing in this section shall give the owner of private lands any right to any precious stones therein or thereon. (3 of 1901, s. 6.)

(6) Nothwithstanding anything in this or any other Ordinance contained, no grant of Crown Land made after the passing of this Ordinance, shall be deemed to confer upon the grantee any right to any mineral or metal whatsoever, in such Crown Land, and all such minerals and metals shall remain the absolute property of His Majesty.

36. The provisions of sections 29, 30 and 32 of this Ordinance respecting licences shall also apply to licences issued under this Part of the Ordinance.

Certain provisions relating to mining licences on Crown lands to apply in the case of private lands.

Part V.—Mining Partnerships.

37.—(1) A mining partnership exists when two or more persons own or acquire a claim for the purpose of working it, and actually engage in working it, or jointly employ others to work it for them ; and whether there is a written contract of partnership or not.

Definition of mining partnership.

(2) An express agreement to become partners, or to share the profits or losses of mining, is not necessary to the formation or existence of a mining partnership. The relation arises out of the ownership of shares in a claim, and working the same for the purpose for which the concession for it was granted, or the licence in respect of it was issued. (15 of 1896, s. 3.)

38. Any claim owned and worked by partners in mining, whether purchased with partnership funds or not, is partnership property. (15 of 1896, s. 4.)

Claim worked by partners.

39. A member of a mining partnership shares in the profits and losses thereo in the proportion which the interest or shares he owns in the claim bears or bear to the whole number of shares. (15 of 1896, s. 5.)

Share of partner in profits and losses.

40. Each member of a mining partnership has a lien on the partnership property for the debts due to the creditors of the partnership and for money advanced by him for its use. (15 of 1896, s. 6.)

Lien of partner on partnership property.

41. Any person owning a share or interest in any claim or in any mining company owning or working any claim or any agent authorized in writing by him shall be entitled, at any time between the hours of ten o'clock in the forenoon and four o'clock in the afternoon of any working day, to enter the claim, with or without an expert, and to inspect the same and all the workings and mining

Right of person owning share in mine to inspect same.

operations therein ; and for such purpose the said person or his agent and expert shall have at all times free ingress, and egress from the claim. (15 of 1896, s. 7.)

Penalty on mining manager, etc., preventing inspection of claim.

42. Every manager of a claim, or director or manager of any company as aforesaid, who prevents, obstructs, or delays, or causes the prevention, obstruction, or delay of any person or expert as aforesaid from entering any such claim shall be liable to a penalty not exceeding one hundred dollars, and to a further penalty not exceeding ten dollars for every day during which such prevention, obstruction, or delay continues. (15 of 1896, s. 8.)

Transfer of interest of partner.

43.—(1) One or more of the partners in a mining partnership may convey or assign his interest in the claim without dissolving the partnership and without the consent of other members : Provided that the sale of such interest shall in the first instance be offered to and refused by the other members. (15 of 1896, s. 9 (1).)

(2) The purchaser from the date of his purchase shall become a member of the partnership : Provided, however, that no transfer shall be allowed or made unless the remaining partners have intimated in writing to the Commissioner that the transferor has made provision for the payment of his share of the debts due by the partnership, or unless the transferor can otherwise satisfy the Commissioner that such provision has been made. (15 of 1896, s. 9 (2).)

Mode of binding partnership.

44.—(1) No member of a mining partnership, or any agent or manager thereof, can by a contract other than a contract for the employment of labourers, bind the partnership except by express authority in writing derived from the members thereof.

(2) The decision of the members owning a majority of the shares or interests in a mining partnership binds it in the conduct of its business. (15 of 1896, s. 10.)

Dissolution of partnership.

45. It shall be a ground for dissolution of a mining partnership if any member of a partnership refuses or neglects, within thirty days after personally receiving notice in writing thereof from the other partner or partners, to pay or satisfy any assessment of the partnership liabilities or neglects, when notified in writing by the other partner or partners to do so, to perform any labour or discharge any liability incurred. (15 of 1896, s. 11.)

Application of preceding sections.

46.—(1) Part V. of this Ordinance shall not apply to any Company or Association incorporated or registered under the Companies Ordinance, 1898, and the application of all or any of its sections may be expressly limited or excluded by a written contract or partnership. (15 of 1896, s. 12.)

(2) The Partnership Ordinance, 1900, shall not apply to any question provided for in Part V. of this Ordinance where this Ordinance applies to the partnership in connection with which such question has arisen. (20 of 1900, s. 48 (2).)

Part VI.—Prevention of Theft of Gold or of Precious Stones.

Presumption as to possession.

47. For the purposes of this Ordinance, a person shall be deemed to be in possession of raw gold or of precious stones if it or they is or are at the time in his custody or power or under his control, although not in his actual possession. (3 of 1887, s. 7.)

48. Every person in whose possession raw gold or precious stones is or are found by any Officer shall be guilty of an offence against this Ordinance, unless he can prove, to the satisfaction of the Court before which he is tried, that he is lawfully entitled to the possession of the same. (3 of 1887, s. 8.) **Possession an offence unless justified.**

49. Any Officer who has reasonable cause to suspect that any person is unlawfully in possession of or removing any raw gold or precious stones may stop and examine such person, and any vessel, or any cart or other conveyance, in the possession of or under the control of such person or in which such person may be, and any package under the control of such person ; and if any raw gold or precious stones is or are found upon such person or in any such vessel, cart, conveyance, or package, may seize and detain the same and arrest and detain such person until he can be brought before a Magistrate and dealt with according to law. (3 of 1887, s. 9.) **Powers of officers.**

50. Nothwithstanding anything in this Ordinance,and in addition to the powers therein contained, it shall be lawful for the Commissioner or any Warden, with a view of ascertaining whether any person is unlawfully in possession of or removing any raw gold or precious stones— **Powers of officers to search persons.**

(1) To stop any person within a Mining District, and demand the production of all raw gold or precious stones in his possession ;

(2) To search or cause to be searched in his presence any person within a Mining District and everything in his possession or under his control ; and,

(3) To search or cause to be searched any person, and everything in his possession or under his control, wherever such person may be within the Colony, who has come from a Mining District, within seven days after leaving such district. (3 of 1887, s. 10.)

1. If any Officer has reasonable cause to suspect that any raw gold or precious stones is or are in the unlawful possession of any person in any house, store, shop, building or other enclosed place whatsoever within the Colony, then, upon oath made by such Officer before any Justice of the Peace of the fact of such suspicion, such Justice may, by warrant under his hand, authorize such Officer, with all necessary assistance, to enter by force if required, and at any hour of the day or night, such house, store, shop, building or other enclosed place, and to seize and detain any raw gold or precious stones found therein, and to arrest and detain the owner or occupier or the person in charge of such house, store, shop, building or other enclosed place, and the person or persons in whose possession such raw gold or precious stones may be found, until he or they can be brought before a Magistrate and dealt with according to law. (3 of 1887, s. 11 (1).) **Powers of officers to search premises.**

52.—(1) For the purposes of examination and search under this Ordinance, it shall be lawful for any Officer if he thinks fit to cause any person to be taken to the nearest Police Station or other station appointed for the purpose of this Ordinance. **Suspected person may be taken to a station.**

(2) A female shall be searched only by a duly appointed female searcher alone or in the presence of another female notwithstanding anything to the contrary in section 50 hereof. (3 of 1887, s. 12.)

53. Any raw gold or precious stones produced on demand or discovered on search may be seized and detained by the Officer, who may also arrest and detain the person from whom the gold or precious **Raw gold and precious stones may be detained and possessor arrested.**

stones was or were seized until he can be brought before a Magistrate and dealt with according to law. (3 of 1887, s. 13.)

Custody of seizures made.

54. All raw gold or precious stones seized shall as soon as possible be conveyed under the care of some responsible person to the Inspector or other officer of Police or if there is no officer of Police in the district the Magistrate of the District in which the same was seized, and the Inspector or other officer of Police or the Magistrate shall make such provision for the safe custody thereof as he may deem advisable. (3 of 1887, s. 14, and 15 of 1896, s. 28 (3).)

Complaint to be preferred forthwith.

55.—(1) As soon as possible after the seizure of any raw gold or precious stones a complaint shall be preferred against the person from whom the same was seized for the unlawful possession thereof.

Procedure thereon.

(2) Such complaint may be preferred by the seizing Officer or by any other Officer.

(3) On the hearing of such complaint the complainant shall prove—

(*a*) The finding of the raw gold or the precious stones in the possession of the person charged ; and

(*b*) Reasonable cause, at the time of seizure, or, in the case of the Commissioner or Warden acting under section 50 of this Ordinance, either at the time of seizure or from information subsequently obtained to suspect that such possession is unlawful ; and thereupon the onus shall lie upon the person charged of proving to the satisfaction of the Court, that he is lawfully entitled to the possession of such raw gold, or precious stones. (3 of 1887, s. 15.)

Delivery to rightful owner.

56. If on the trial of any person in respect of such raw gold or precious stones it is proved to the Magistrate's satisfaction to whom the gold or precious stones belongs or belong, the Magistrate may make an order for the delivery thereof to the rightful owner on payment of the royalty and of such expenses as, in his opinion, have been properly incurred in recovering such gold or precious stones. (3 of 1887, s. 16.)

Adjudication of claim to ownership in case of doubt.

57.—(1) In the event of there being no proof or not sufficient proof as to the ownership of any gold or precious stones seized, the Magistrate shall advertise such seizure with particulars thereof, for four successive Saturdays in the Gazette and one other newspaper circulating in the Colony, and any person having any claim thereto may, on or before the last Saturday on which such seizure is required to be advertised, give notice in writing thereof to the Magistrate, whereupon the Magistrate shall fix a day and hour for the hearing of any claim or claims so made and shall adjudicate thereon in a summary manner.

(2) If, on such hearing the Magistrate is of opinion that the claimant has established his claim, he shall order the gold or precious stones to be delivered up, after payment of such royalty and expenses as aforesaid.

(3) If such claim is not established or no claim be made the Magistrate shall thereafter transmit such gold or precious stones to the Commissioner to be dealt with as the Governor may direct. (3 of 1887, s. 17.)

(4) The Warden, the Commissioner, or any Officer of the Department of Lands and Mines authorized by him in writing, shall have the right to appear and be heard at any proceedings taken under Part VI.

of this Ordinance, and shall have the same rights in all respects as if he were a party thereto.

58. Any order of a Magistrate under this Ordinance shall be subject to appeal. (3 of 1887, s. 18.) Right of appeal.

PART VII.—OFFENCES.

59. Every person who— Liability of person not reporting at station, etc.

(1) Fails to report himself to the proper station, or

(2) Fails to attend at any station when required by an officer to do so, or

(3) Refuses to allow himself or anything under his control to be examined and searched,

shall be guilty of an offence against this Ordinance. (3 of 1887, s. 21.)

60.—(1) Every person who— Penalty for harbouring registered labourer and proceedings in such case.

(*a*) Harbours, conceals, or employs any servant while his contract of service with another person subsists ; or

(*b*) Removes or entices any such servant from the service of his employer, or solicits or entices him to leave such service,

shall be guilty of an offence against this Ordinance, and on conviction thereof shall be liable to a penalty not exceeding one hundred dollars, and shall further pay to the employer the sum of two dollars for every day during which such servant has been so harboured, concealed, or employed. (15 of 1896, s. 13 (1).)

61. Every person who— Fraudulent dealing with licence.

(1) Fraudulently personates the holder of any licence or concession ; or

(2) Falsely represents that any servant or other person is an authorized holder of any licence ; or

(3) Fraudulently exhibits as his own any licence issued to another person ; or

(4) Uses or exhibits as valid any licence which has expired,

shall be guilty of an offence against this Ordinance. (15 of 1896, s. 14.)

62. Every person who unlawfully obtains any gold, silver, valuable minerals or precious stones, or who procures or employs any other person to unlawfully obtain, convey, or dispose of any gold, silver, valuable minerals or precious stones shall, in addition to any punishment incurred for a breach of the Mining Regulations, be guilty of an offence against this Ordinance. (3 of 1887, s. 22.) Unlawfully procuring or disposing of gold or precious stones.

63. Every person who sells or purchases any gold or any precious stones in a Mining District otherwise than in accordance with the Mining Regulations, shall be guilty of an offence under this Ordinance. (15 of 1896, s. 15.) Selling gold or precious stones contrary to regulations.

64. Every person who, with intent to defraud his co-owner, co-partner, or co-adventurer in any claim or in any share or interest in any claim, secretly keeps back, conceals, or disposes of any gold, silver, valuable minerals or precious stones found in or taken from such claim, shall be guilty of an offence against this Ordinance. (3 of 1887, s. 24 amended.) Cheating mining partner.

Penalty for breach of ordinance.

65. Every person who is guilty of an offence against this Ordinance for which no penalty is otherwise expressly provided shall be liable to a penalty not exceeding five hundred dollars, and in default of payment forthwith or within such time as the Court may direct, to imprisonment with or without hard labour for any term not exceeding six months, and on the second or any subsequent conviction to imprisonment with or without hard labour for any term not exceeding six months, and in addition to a penalty not exceeding five hundred dollars. (3 of 1887, s. 23.)

Part VIII.—Procedure.

Change of venue.

66.—(1) Where an offence against this Ordinance has been committed within the jurisdiction of one Magistrate, and the Commissioner certifies in writing that in his opinion the complaint for any such offence can be more conveniently or fairly heard before the Magistrate of any other district in the colony, it shall be lawful for such other Magistrate, and he is hereby required, to hear and determine such complaint as if the offence had been committed within his jurisdiction. Provided that the venue shall not be so changed, except with the consent in writing of the parties or the approval in writing of the Attorney-General.

(2) In the event of proceedings being taken under this section before the Magistrate of a District other than that in which the offence was committed, all gold, silver, valuable minerals or precious stones seized and dealt with under this Ordinance shall be sent on to such Magistrate, and all further proceedings in respect thereof shall be had and taken by and before him. (3 of 1887, s. 25.)

Statement of reasons for seizure receivable in evidence.

67. On the trial of any person in respect of the unlawful possession of raw gold or precious stones seized by an officer or of any claim thereto under this Ordinance the production of a written statement purporting to be signed by such officer giving his reason for such seizure and the circumstances under which it was made shall, with the consent of the defendant, be *primâ facie* evidence of the facts therein stated. (3 of 1887, s. 26 amended.)

Account of wages receivable in evidence.

68. Any Certificate of Registration issued under the Mining Regulations and any account of salary or wages of a servant employed on a claim, certified by the holder of such claim or person in charge thereof, shall in all courts be *primâ facie* evidence of all matters contained or endorsed therein or thereon respectively. (15 of 1896, s. 16.)

Service of process in proceeding for recovery of wages.

69. In any proceeding by a servant employed on a claim for the recovery of salary or wages for working thereon, delivery of any process at the registered address of the person who was the holder of such claim, at the time when the proceedings were commenced shall have the same effect as personal service on every person liable for payment thereof. (15 of 1896, s. 17.)

Powers of Commissioner and Warden.

70. The Commissioner or a Warden shall for the purpose of determining any disputes which he is by the Mining Regulations empowered to determine, have the same powers as to summoning witnesses and compelling their attendance, as to employing bailiffs, police, or rural constables, as to the examination of witnesses, and as to adjournments, as are for the time being vested in a Magistrate in the exercise of his jurisdiction under the Petty Debts Recovery Ordinance, 1893. (15 of 1896, s. 20.)

71. All fees or costs awarded payable under the Mining Regulations in proceedings for the determination of disputes by a Warden or by the Commissioner shall be recoverable by action. (15 of 1896, s. 21.) Fees on proceedings before Wardens or Commissioner.

72. In all cases in which the Mining Regulations provide that any person who is aggrieved by any decision of the Commissioner or of a Warden may appeal from such decision to the Supreme Court, the Court in its limited jurisdiction shall have full jurisdiction to hear and determine all questions of fact and of law between the parties raised in appeal, and the parties to any such proceeding may appeal from any decision of the Court in its limited jurisdiction to the Full Court. (15 of 1896, s. 22.) Right of appeal to Supreme Court.

73. The appellant shall, within six weeks after the pronouncing of the decision, serve upon the Commissioner and upon the opposite party notice in writing of the reasons for his appeal, and such notice may be served either personally or by registered letter: Provided, however, that in any case where a person who is entitled to appeal from any such decision as aforesaid is unavoidably prevented from appealing within the time hereinbefore specified, it shall be lawful for such person to apply, by motion to the Court, for leave to appeal from such decision, and the Court may either refuse to grant such leave or may grant the same on such terms and conditions as it may think fit. (15 of 1896, s. 23.) Notice of appeal.

74. The appellant shall, within one month after the date of the decision appealed against, enter into a recognizance with at least one sufficient surety, in fifty dollars, to the satisfaction of the Commissioner or Warden, conditioned for the due prosecution of the appeal and for abiding the result thereof, including the payment of all costs of the appeal and otherwise. Security in appeal.

75. Subject to the provisions of this Ordinance, the practice and procedure in respect of any such appeal shall be the same as the practice and procedure for the time being in force in the Court in respect of appeals from the decisions of Magistrates. (15 of 1896, s. 24.) Practice and procedure in appeal.

76. The decision of the Judge shall bind the parties but shall give no right as against the Crown or any Officer of the Government, and shall not be deemed to confer any right to obtain a concession or licence under this Ordinance. (15 of 1896, s. 25.) Effect of decision in appeal.

77. The Court may, at any time after proceedings in appeal have been commenced, on motion by either party, order that all work shall cease on a claim, either generally or by any particular person or persons, pending the decision of the matter. (15 of 1896, s. 26.) Power to Supreme Court to order to cease work on claim.

78. The fees and costs payable on appeals shall be the same as in cases within the General Civil Jurisdiction of the Supreme Court, and the remuneration of witnesses shall be the same as in the Supreme Court, Civil Jurisdiction. (15 of 1896, s. 27.) Fees and costs on appeal.

79.—(1) In any case where an employer or his agent satisfies a Magistrate or Justice of the Peace, by information upon oath, that Procedure in case of prosecution for harbouring servant.

his servant whose contract of service is subsisting is harboured, concealed, or employed by another person, the Magistrate or Justice of the Peace may issue a warrant to any officer to search any premises of or occupied by such person for such servant, and to bring him, if found, and the person by whom he is harboured, concealed, or employed, before a Magistrate, to be dealt with according to law. (15 of 1896, s. 13 (2).)

(2) In any proceeding under this Section or under Section 61 it shall not be necessary to prove on behalf of the prosecution that the defendant knew that the servant was under a subsisting contract of service ; but in any such proceeding it shall be a sufficient defence for the defendant to prove that he did not know, and had no reasonable means of knowing, that the servant was under such contract of service. (15 of 1896, s. 13 (3).)

(3) Where a servant is harboured, concealed, or employed as aforesaid on a claim, the holder of the claim, and the principal person in charge thereof shall each be liable to the penalty enacted in Section 61 of this Ordinance. (15 of 1896, s. 13 (4).)

Prosecution of offences.

80. Any offence created or penalty imposed by this Ordinance or by any Regulations made thereunder may be prosecuted or recovered under the Summary Jurisdiction Ordinances. (15 of 1896, s. 30.)

Part IX.—Miscellaneous.

Power to make regulations.

81.—(1) The Governor and Court of Policy may make regulations, and when made, may alter, amend or revoke such regulations, with respect to all or any of the following matters :—

(*a*) The prospecting and locating of Claims and the issue of licences ;
(*b*) Filing of objections ;
(*c*) Duration of Licences, and size and extent of Claims ;
(*d*) Mode of working Claims and deposit of waste and tailings ;
(*e*) Keeping of records of gold, silver, and valuable minerals, and of precious stones found ;
(*f*) Definition of boundaries and maintenance of boundary marks ;
(*g*) Applications for and issue of dredging concessions, and the conditions affecting them ;
(*h*) The amalgamation, purchase, and transfer of claim licences and concessions ;
(*i*) Surveys ;
(*j*) The regulation of the use of the surface of the land, and of the cutting of timber and fuel ;
(*k*) Water rights and the use of water ;
(*l*) Permits to occupy land for purposes connected with mining ;
(*m*) Cutting of paths and trails, and the use of them ;
(*n*) Jumping of claims ;
(*o*) Employment and registration of labourers, the payment of wages, and the duties of employers ;
(*p*) The conveyance, detention, sale, and purchase of gold, silver, valuable minerals, and precious stones ;
(*q*) Duties of traders in gold or precious stones ;
(*r*) The sanitary regulation of claims and places adjacent to claims ;

(*s*) The regulation of mines;
(*t*) The determination of disputes;
(*u*) Employment and rights of Aboriginal Indians;
(*v*) Disposal of forfeited gold, silver, or valuable minerals, or precious stones;
(*w*) The determination of the amounts to be paid for royalty, fees of office, and other amounts payable to the Colonial Government;
(*x*) The regulation of the conditions on which entry may be made on private lands and the securing to the persons entitled thereto due compensation for any disturbance of the surface of the land; and
(*y*) All matters not hereinbefore specially mentioned connected with the search or mining for or dealing with gold, silver, valuable minerals or precious stones, and generally all matters connected with the proper carrying out of the provisions of this Ordinance.

(2) In any such regulation the Governor and Court of Policy may prescribe such penalty, not exceeding one hundred dollars, as they may think fit for any breach of any Regulation.

(3) Every person who is guilty of a breach of any regulation for which no penalty is expressly provided shall be liable to a penalty not exceeding one hundred dollars. (12 of 1895, s. 5.)

(4) All such Regulations shall be published in the Gazette, and shall have the force of law.

Mining Regulations. First Schedule.

82. Until the Governor and Court of Policy make Regulations under the last preceding section hereof, the Regulations in the First Schedule to this Ordinance shall be in force as the Mining Regulations, but such Regulations may be altered, amended or revoked in the same manner as if they were Regulations made by the Governor and Court of Policy under the said last preceding section.

Penalty for breach of the Regulations.

83. Every person who is guilty of a breach of any of the Regulations,—

(1) By refusing or neglecting to comply with any duty imposed on him by or under the Regulations; or
(2) By refusing or neglecting to comply with any lawful order or direction given by an Officer; or
(3) By obstructing an Officer in the execution of his duty; or
(4) By giving incorrect information in relation to any matter within his knowledge;

shall be liable to a penalty not exceeding one hundred dollars.

Forfeiture of licence for breach of conditions.

84. Any holder of a licence issued under this Ordinance or under the Mining Regulations, who is guilty of a breach of any condition expressed in his licence, or of a breach of any Regulation relating to licences of the kind held by him, shall, in addition to any other penalty provided for such breach, if the Governor-in-Council so orders, forfeit his licence.

Forfeiture of gold or precious stones, in respect of which an offence is committed.

85.—(1) All gold, silver, valuable minerals or precious stones removed, conveyed, purchased or otherwise dealt with contrary to this Ordinance or to the Mining Regulations may be seized by any Officer, and if any person is convicted of any offence in respect of such gold, silver, valuable minerals or precious stones, the Magistrate may order the same to be forfeited, or delivered to the person who appears to be entitled thereto.

(2) If the person from whom any gold, silver, valuable minerals or precious stones are taken, is not convicted of any offence in respect of the same, or is not prosecuted for any offence, or if the Magistrate has not made any order under sub-section (1) hereof, the officer may detain such gold, silver, valuable minerals or precious stones until such person, or any other person claiming the same, satisfies him or a Court of competent jurisdiction that he came by the same lawfully, or has a good title to the same.

(3) All gold, silver, valuable minerals or precious stones so seized as aforesaid, to which no claim is made or sustained within six months from the date of such seizure, may be forfeited by the Governor.

Liability for negligence involving personal injury.

86. Every person who, either by himself, his agent, or servant, is guilty of any negligence in relation to any matter dealt with in the Regulations by which any person is injured shall, in addition to any action to which he may be liable, be deemed guilty of a breach of the Regulations.

Reward to informer.

87. Any person giving information as to the breach of the Regulations respecting the removal or conveyance of or dealing with any gold, silver, valuable minerals or precious stones which leads to the forfeiture thereof shall be entitled to such portion of the proceeds therefrom as the Governor may award.

No officer to engage in mining enterprise.

88.—(1) Every officer holding a salaried appointment in the Department of Lands and Mines is hereby prohibited from acquiring by any cat of his, or holding directly or indirectly any share or beneficial interest in any claim in this colony, or in any concession granted or licence issued under this Ordinance.

(2) If any such share or interest devolves upon any such officer by will or inheritance or from any circumstances beyond his control, he shall immediately on the fact becoming known to him report the same to the Governor, who shall give such directions in the matter as he thinks expedient in the public interest.

(3) If any such officer

(*a*) Acquires or holds any such share or interest contrary to sub-section (1) hereof, or

(*b*) Fails to report the fact of any such share or interest having devolved upon him as required by sub-section (2) hereof, or

(*c*) Refuses or neglects to comply with any directions given by the Governor in respect of any share or interest which has devolved upon him,

he shall, on being convicted thereof before a Magistrate, on proceedings taken against him with the consent in writing of the Attorney-General be liable to a penalty not exceeding five hundred dollars for every such offence and shall be subject to dismissal from the public service. (3 of 1887, s. 28.)

Salaries of officers.

89. All officers appointed under this Ordinance shall respectively receive such salaries as may from time to time be assigned to them by the Combined Court. (3 of 1887, s. 20.)

Duration of ordinance.

90. All royalties, rent, fees and other moneys payable under this Ordinance, or under the Mining Regulations, shall be paid over to the

Receiver-General for the use of the Colony so long as the Legislature of the Colony make due provision to the satisfaction of His Majesty, for maintaining the Civil List Establishment of the Colony. (3 of 1887, s. 29, amended.)

91. The Ordinances mentioned in the Second Schedule to this Ordinance are hereby repealed to the extent specified in the third column of that Schedule. **Repeal—Second Schedule.**

Provided that—

(1) This repeal shall not affect the validity of any licence, concession, certificate or document issued, granted or made under the authority of any enactment hereby repealed; and

(2) Any document referring to any Ordinance or enactment hereby repealed shall be construed to refer to this Ordinance, or to the corresponding enactment in this Ordinance; and

(3) This repeal shall not affect—

(*a*) Any right, privilege, obligation or liability acquired, accrued or incurred under any enactment or regulation made under any enactment hereby repealed; nor

(*b*) Any penalty, forfeiture or punishment incurred in respect of any offence committed against any enactment, or regulation made under any enactment, hereby repealed; nor

(*c*) Any investigation, legal proceeding or remedy in respect of any such right, privilege, obligation, liability, penalty, forfeiture or punishment as aforesaid; and any such investigation, legal proceeding, and remedy may be carried on as if this Ordinance had not passed.

92. All Regulations made before the passing of this Ordinance, under the authority of any Ordinance or enactment repealed by the last preceding section, are hereby revoked and rescinded. **Revocation of Regulations.**

BRITISH GUIANA.

THE MINING REGULATIONS, 1905.

Preliminary.

Short title.

1. These Regulations may be cited for all purposes as the Mining Regulations, 1905.

Interpretation of terms.

2. In these Regulations, unless the context otherwise requires,—

"Gold" includes amalgam silver and valuable mineral found in or taken from any part of the Colony, in whatever condition, until the same has or have passed through the Commissioner's Office and royalty has been paid thereon and thereafter, whilst subject to these Regulations;

"Amalgam" means gold combined with quicksilver;

"Mining Inspector" means any person appointed by the Governor to be an Inspector for the purposes of Part X. of these Regulations.

Expressions in these Regulations referring to weights and measures shall be construed as referring to Imperial weights and measures.

PART I.

Prospecting and Locating of Claims and Issue of Prospecting Licences.

Form and requisites of application for prospecting licence. Form No. 1.

3.—(1) Every person who desires to prospect for the purpose of locating claims shall apply in writing, in Form No. 1 in the First Schedule to these Regulations, to the Commissioner or Warden for a licence hereinafter called a prospecting licence to do so, and shall produce, if required by the Commissioner, a certificate from the Institute of Mines (which certificate shall be given free of charge by the Institute) that he is not a labourer under a subsisting contract.

(2) The application must contain the full name and address of each applicant, and each applicant or his attorney duly authorised by power of attorney deposited or recorded in the Registrar's Office, must sign the same in the presence of two witnesses, who must also sign the application. The application must also contain the name, style or firm, if any, by which it is intended that the prospecting and working is to be carried on and also an address in Georgetown, called a "registered address," at which all notices or other process necessary for the purposes of these Regulations may be served.

(3) No prospecting licence shall be issued in the name of any firm, syndicate or partnership, unless the name or names and addresses of the person constituting such firm, syndicate or partnership are stated

in writing, signed by such persons to the Commissioner or Warden, and such persons shall for all purposes be subject to all the obligations imposed by these Regulations on the holders of such licences.

(4) Where a licence is applied for in the names of more than one person, the licence shall be granted to one of such persons only for and on behalf of himself and the other persons named in the application.

(5) The Commissioner or Warden shall not issue a prospecting licence to any person known to be a minor, and if any such licence is issued to a minor it shall be null and void.

(6) The Commissioner or Warden may refuse to issue a prospecting licence, but where the Commissioner or Warden refuses to issue a licence, the applicant may appeal to the Governor whose decision shall be final.

(7) It shall not be lawful for any person employed on a claim to apply for, receive or hold a prospecting licence except for and on behalf of his employer.

Issue, etc., of prospecting licence.

Form No. 2.

4.—(1) If the application is granted the Commissioner or Warden shall, subject to the provisions of sub-section (1) of Regulation 6, thereupon issue a prospecting licence to the applicant, in Form No. 2 in the First Schedule to these Regulations.

Schedule II.

(2) There shall be payable in advance for the licence the sum specified in the Second Schedule to these Regulations.

(3) The licence shall continue in force for twelve months from the date of its issue.

(4) It shall be lawful for the Commissioner for good cause at any time to revoke any prospecting licence, subject to an appeal to the Governor, whose decision shall be final.

(5) Subject to the provisions of sub-section (1) of Regulation 6, a prospecting licence shall entitle the person to whom it is issued to prospect and locate claims in every Mining District, but under and subject to the provisions of these Regulations.

(6) A prospecting licence issued to any person shall, unless he is informed by the Commissioner or Warden that his location is disallowed or is ordered to suspend work, be deemed to entitle and to have entitled him to work the ground located thereunder from the date of location until his application for a claim licence can be published and such licence either issued or refused.

Provided that nothing contained in this section shall be held to make valid any location made by a person who has not previously taken out a prospecting licence.

5.—(1) The Commissioner or Warden shall file and preserve all applications and on receipt of any notice of change of address shall endorse thereon the date of receipt and shall file and keep such notice with the application to which it relates.

Schedule II.

A certified copy of the particulars relating to any prospecting licence shall be given to any person demanding the same on his paying therefor the fee specified in the Second Schedule to these Regulations.

(2) The Warden shall without delay report in writing to the Commissioner all prospecting licences issued by him and the Commissioner shall file and preserve such report.

Keeping of record of particulars relating to prospecting licences.

(3) A registered address shall not be changed until notice in writing of the intention to change the same has been served on the Commissioner or Warden by the person or all the persons if more than one who applied for the licence.

(4) Delivery of any notice or process required by these Regulations at a registered address for the time being shall have the same effect as personal service.

Locating of Claim.

Prospecting for and locating of claim.

Form No. 3.

6.—(1) A person on obtaining a prospecting licence may, personally or by some person authorised by him with the approval of the Commissioner or Warden in writing in Form No. 3 in the First Schedule to these Regulations, prospect for and locate claims on any of the Crown Lands in the Colony not previously lawfully occupied or previously located or reserved, by notice published in the Gazette for the use of the Crown, or the Colony or as an Indian Reservation. Any location not made in compliance with this Regulation shall be disallowed by the Commissioner.

(2) When a licence has been granted to one person for and on behalf of himself and the other persons signing the application for the licence, as provided in sub-section (4) of Regulation 3, only the person authorised under such licence to act on behalf of the other persons named in the licence, or some person duly authorised by him in writing in Form No. 3 in the First Schedule to these Regulations, shall be entitled to enter a mining district by virtue of the licence so granted or to prospect or locate claims under such licence.

The name of the person to whom it is desired that the licence should be granted, shall be stated in writing to the Commissioner or Warden, at the time the application for the licence is lodged.

Notice of Location of Claim, and Application for Licence.

Giving notice of location and application for licence.

Form Nos. 4 and 5.

7. Every person who locates a claim shall, within a reasonable time after such location, and in any case not more than three months thereafter, file or caused to be filed at the office of the Warden, or at the office of the Department of Lands and Mines in Georgetown, a notice in duplicate, in Form No. 4 in the First Schedule to these Regulations, stating the name of the person for whom the location is made, the name of the person actually locating, the names of the witnesses in whose presence the location was made, the date of the location, and such a description of the ground located and its situation as will enable the claim to be identified by the Warden together with an application in writing in Form No. 5 in the said Schedule for a licence to mine for gold or to mine for precious stones or to mine for gold and precious stones as the case may be and shall pay for filing such notice and application the fee specified in the Second Schedule to these Regulations, and if such application and notice be not filed as required with the amount payable, the location shall be null and void, and the land located be open to location by anyone.

Recording of notice and application.

Form No. 6.

8.—(1) The Warden or Commissioner, on receiving such notice in duplicate and application, shall mark on each of them the time when it was received, shall file and preserve the same, and give to the person filing the documents a receipt in the Form No. 6 in the First Schedule to these Regulations.

(2) The Warden shall file in his office one copy of the notice and shall forward the other, together with the application, by the first opportunity to the office of the Commissioner, and shall at the same time furnish to the Commissioner such information, if any, respecting such location and application as he may think requisite.

9. Where any dispute arises as regards the person who is to be deemed the first applicant for a licence, the person first locating the claim in accordance with these Regulations shall be deemed the first applicant. **Rule of decision as to first applicant.**

10. Any claim located by any person under a prospecting licence obtained in contravention of Regulation 3 (7) hereof or by any person who at the time of such location is in the employment of the holder of a prospecting, or claim licence or concession shall be deemed to have been located for and on behalf of his employer. **Claim located by employé.**

11. On receiving the notice and application, the Commissioner shall cause the same to be published in the Gazette for three successive Saturdays, in order to allow of any opposition to the issue of a licence therefor being made, in the manner hereinafter provided. **Publication of notice of location.**

12. All gold or precious stones obtained by any person from any land, pending the issue of a licence, after locating a claim, shall be subject to the same regulations and shall be recorded and dealt with in all respects as if it or they had been obtained after the issue of a licence. **Right to gold obtained by provisional working of claim.**

Objections to Issue of Licences.

13.—(1) Any person who desires to object to the issue of a licence shall file at the office of the Commissioner his reasons of opposition in writing in duplicate on or before the last Saturday on which the application is required to be published, and shall deposit at the same time a sum of twenty-five dollars in respect of each licence to which objection is made to meet expenses, other than those of the Officer who decides the case, such sum to be dealt with as such Officer may decide: Provided that where more than one licence is objected to by the same person, the Commissioner in his discretion may reduce the amount to be deposited in respect of the second and subsequent licences. **Making of objection to granting of claim licence.**

(2) Every such person shall be bound, within three days after such filing, to serve at the registered address of the applicant for the licence a copy of such reasons; and the procedure shall, *mutatis mutandis*, be in accordance with the provisions of Part XI. of these Regulations.

Issue of Licences.

14.—(1) If there is no opposition to the issue of a licence, or if there is opposition but it is decided in favour of the applicant, and the boundaries of the claim have been verified to the satisfaction of the Commissioner a licence may be issued for the land so located in Form No. 7 in the First Schedule to these Regulations. **Restrictions on issue of licence, etc.** **Form No. 7.**

(2) Every applicant for a Claim Licence when required by the Warden to do so shall either by himself or by some other duly authorised person deputed by him, point out to the Warden the position and boundaries of the Claim for which a Licence is sought, and if such applicant fails to have such claim pointed out and verified within six weeks after the Warden has notified him of his readiness to verify the location, the application for the same shall be cancelled and a notice to this effect shall be published by the Commissioner in the Gazette and thereupon the location shall be null and void and the land open to location by any person.

(3) A licence shall not be issued to any person known to be a minor, and if any licence is issued to a minor it shall be *null* and *void*: Provided always that where the right to obtain a licence devolves by will or on intestacy to a minor, a licence may be issued to the guardian of such minor, and such guardian shall thereupon become subject to all the obligations imposed by these Regulations on the holder of a licence.

(4) The Governor may direct that a licence shall not issue to any person who has been convicted of any indictable offence, or of the larceny of gold or of any offence under the Mining Ordinance, 1903, or any Regulations made thereunder or against whom any unsatisfied judgment for labourers' wages exists, or against whom any judgment or sentence for any ill-treatment or neglect of any labourer employed by him has been given, and thereupon the location shall be void and the land open to location by any other person.

(5) No licence shall be issued in the name of any firm, syndicate, or partnership, unless the name or names and addresses of the persons constituting such firm, syndicate, or partnership are stated in writing signed by such persons to the Commissioner, and such persons shall for all purposes, until transfer of the licence, be subject to all the obligations imposed by these regulations on the holders of such licences.

(6) If the applicant for a licence does not, within 14 days after the last Saturday's advertisement of his application, or within the same period after the removal of any opposition entered, pay the rent (if any) payable in advance for such licence, such licence shall not be issued, and the application for such licence shall be declared abandoned by the Commissioner by notice in the Gazette for three consecutive Saturdays, and the land referred to therein shall be open to location by any person.

General rights conferred by claim.

15.—(1) A licence, so long as the holder thereof complies with the Mining Ordinance, 1903, and with the Mining Regulations, shall, subject to its terms, confer the right to the use and enjoyment of the surface included within the lines of the claim, and to all veins, lodes, ledges, and deposits below such surface, within the vertical planes in which the surface boundaries lie :

Provided always that, subject to the provisions hereinafter contained relating to a path or trail, the occupation of all lands for the purpose of being worked under these Regulations shall be subject to the right of any person to pass through or along any road or path on such land which gives access to any land beyond, to which such person desires and is entitled to go, and to the rights of any person duly authorised to cut timber or take forest produce.

Duration, etc., of Licence.

Revocation for non-working.

16. Any licence may be revoked by the Governor-in-Council under and in accordance with the provisions of section 32 of the Mining Ordinance, 1903, if the holder thereof ceases to work the claim to the satisfaction of any Officer appointed by the Governor to inspect the same.

Duration of licence.

17. Subject to the provisions of the Mining Ordinance, 1903, and to these Regulations every licence shall continue in force so long as the rent payable in respect thereof is regularly paid.

18.—(1) In the month of June in each year the Commissioner shall, for three consecutive Saturdays, including the first Saturday, advertise for sale on the Tuesday following the third Saturday, the rights of the licensees in all claims for which the rent payable for the current financial year is then in arrear, and shall on the said Tuesday put up the same for sale and sell the same to the highest bidder for cash on the knock of the hammer, whereupon the rights of the licensees in the said claims so sold shall cease and determine. Sale of claims for non-payment of rent.

In the event of a sale being concluded the Commissioner shall give to the purchaser a copy of the licence with a note on the face of it recording such sale, and shall also record the sale on the Register of Licences kept by him :

Provided, however, that the holder of a licence may at any time not later than the day before the sale takes place, pay the rent due in respect of a claim and the sum of fifty cents as cost of the advertisement and the Commissioner shall not sell the same.

(2) All sums received in respect of such sales shall be paid to the Commissioner.

(3) If the right in any claim put up for sale as aforesaid is not sold, the licence issued in respect of it shall *ipso facto* be revoked, and the Commissioner shall give notice of the said revocation in the Gazette, when the said claim shall be open to location by any person.

(4) Every person who abandons a claim shall send in a written notice to the Commissioner or Warden of such abandonment. Abandonment of claims.

(5) The Commissioner shall publish in the Gazette a notice of every such abandonment for three successive Saturdays and the land upon which such claim was located shall after the expiration of one month from the date of the first publication be open to location.

Rent payable in respect of Licences and Royalty.

19.—(1) There shall be payable in advance for each licence the rent specified in the Second Schedule to these Regulations. Fees payable for licence. Second Schedule.

(2) The Commissioner or Warden may detain any gold or precious stones obtained from any claim in case such payment has not been made and sell the same and deduct from the proceeds of such sale the amount due to the Government for such rent.

20. The royalty shall be seventy cents for each ounce of gold and four cents for each ounce of silver, or such amount as may from time to time be fixed by the Governor and Court of Policy. Amount of royalty on gold or silver.

PART II.

Precious Stones Licences.

21. Every person holding a Precious Stones Licence shall be bound immediately after he has commenced to work the land for the purpose of extracting precious stones to notify in writing the Warden of the District in which the land mentioned in the licence is situate, the quantity of land he intends to work and whether the work commenced is in the nature of alluvial working or mining. Notifying quantity and nature of working.

22. If the work commenced is in the nature of mining such holder shall keep a book in the form to be approved by the Commissioner and record therein at least once a week the number of cubic Keeping of record of work.

yards of material removed during the progress of the work ; and shall in addition to all other fees and payments pay a sum of four cents for each cubic yard of such earth, whether the earth contains precious stones or not. The book shall be open at all times to the inspection of the Commissioner or of any Warden.

Giving of security.

23. The holder of such claim worked as a mine shall within three months after the date of the notice mentioned in Regulation 21 give security to the satisfaction of the Receiver General for payment of the sum of money mentioned in Regulation 22 and the holder or his agent having knowledge of the fact shall, at least once every six months after the date the security is given, make a statutory declaration as to the quantity of material so removed and the holder shall pay the amount found due in respect thereof, after the Warden has ascertained and certified it. In case of dispute the quantity so certified is to be taken as correct.

Fee for alluvial working.

24. If the Warden is satisfied that the working is in the nature of alluvial working and the quantity of land mentioned in the notice is correct, he shall give such holder a certificate to that effect and the said holder shall forthwith in addition to all other fees and payments, pay the sum of twenty-five dollars for each quarter of an acre or part thereof mentioned in such certificate.

Marking of alluvial working.

25. When an alluvial working is declared, the area shall be marked by the claimant.

Stones found otherwise than on claims, payment of royalty.

26.—(1) When precious stones are found by any person who has not obtained a licence or concession to mine or work for them, one-tenth in kind or value, at the option of the Commissioner, of all precious stones so discovered shall be paid to the Commissioner.

(2) It shall not be lawful for any person to convey any precious stones found under this Regulation outside the District within which they have been obtained without a permit from the Officer in charge of the nearest Station within the District.

Form No. 14.

(3) On arrival at the Station the person in charge of the precious stones shall deliver them to the Officer in charge, who if he is satisfied that they can be dealt with under this Regulation shall seal the parcel and deliver the same to the person in charge along with a permit in the Form No. 14 in the First Schedule to these Regulations to convey the precious stones to Georgetown, and such stones shall be lodged at the Office of the Department of Lands and Mines within twenty-four hours of their arrival in Georgetown (days on which the Office is closed excepted), and thereupon an Officer of the Department shall, unless the Commissioner shall decide to take the Royalty in kind, certify the amount of Royalty payable, and such Royalty shall thereupon be paid to the Receiver General, and the Receiver General shall give a receipt therefor.

Production of authority to search.

27. Any Officer may require any person exploring or prospecting or searching the ground to produce his concession, licence or authority so to do, and it shall not be necessary for such Officer to prove that such person was searching for gold or precious stones.

Prospecting without authority.

28. Any person exploring, or prospecting or searching the ground (except in the case of private lands) without a concession, licence or authority or refusing or neglecting to produce his concession, licence or authority when required by any Officer shall be guilty of a breach of these Regulations.

PART III.

Marking of Boundaries.

29. Every person locating a claim shall, in the presence of two witnesses, distinctly mark on the ground the limits desired, so that the boundaries may be readily traced. Marking out of limits of claim.

30. All boundaries shall be marked as follows :— Rules as to marking out of boundaries.

(1) By a tree or by a corner post or beacon, not less than three inches square and not less than five feet out of the ground, at each corner of the claim, and by lines distinctly defined from corner to corner by a path not less than four feet wide ; and

(2) On each tree, corner post, or beacon there shall be securely fastened a board or other object, called a location board, on which shall be plainly and permanently marked :—

(*a*) The name of the person for whom the location is made ;

(*b*) The date of the location ;

(*c*) The number of the prospecting licence under which the location is made ;

(*d*) The name of the Creek, Flat or Hill on which the location is made ;

(*e*) Within three months after the issue of the licence, the number and date of the licence.

31.—(1) Every person locating a claim shall, on the issue of the claim licence and on payment of the specified fee, obtain from the Commissioner a metal tablet bearing the Government stamp and a distinctive number, and shall, within three months from the date of the last advertisement of his application as provided for in Regulation 11, or where any opposition has been entered against the granting of the claim licence under Regulation 13, within three months from the date on which such opposition is withdrawn or is decided in his favour, cause such tablet to be affixed to one of the corner trees, posts or beacons of the claim to which it relates. Metal tablet to be affixed to a post on every claim.

(2) The holder of every claim licence, issued prior to these Regulations, shall, on payment of the specified fee, obtain from the Commissioner a metal tablet bearing the Government stamp and a distinctive number, and shall, within six months from the coming into force of these Regulations, cause such tablet to be affixed to one of the corner trees, posts or beacons of the claim to which it relates.

32. No paper or other material attached to a board or other object which may be liable to be washed off shall be deemed a proper marking. Material for marking.

33.—(1) Every holder of a claim whether a licence has been issued or not shall keep the boundaries of his claim distinctly marked out as provided by Regulation 30, and shall keep his location boards in proper order, and in default of his so doing the claim may be jumped : Keeping open of boundaries and penalty for destruction.

Provided always that any person holding a group of contiguous claims for which a concession has been granted or licences have been issued shall not be bound to keep the boundaries of each claim distinctly marked as aforesaid if the external boundaries of the whole group are kept distinctly marked and the location boards in proper order as provided by Regulations 29 and 30 and the tablet referred to in Regulation 31.

(2) Every person who destroys, defaces, injures, or removes, either wholly or in part, any tree, post, beacon, location board, or other marking of a claim, whether in the exercise of any right as regards such claim or otherwise, or procures any other person to do so, shall be deemed guilty of a breach of these Regulations: Provided, however, that a person shall be at liberty to alter the boundaries if he has the permission to do so in writing of the Commissioner or Warden.

When licence revoked or claim abandoned, beacons and boards to be destroyed.

34. It shall be lawful for the Warden—

(*a*) Where a licence has been revoked by the Governor-in-Council under the provisions of section 32 (1) of the Mining Ordinance, 1903 ; or

(*b*) Where the Governor has ordered, in terms of section 32 (2) of the Mining Ordinance, 1903, that a licence shall not be issued ; or

(*c*) Where notice of revocation of a licence has been published in the Gazette as provided in Regulation 18 (3) ; or

(*d*) Where a claim has been abandoned in accordance with Regulation 18 (4),

to pull down, destroy or obliterate any beacons, boards or other marks erected by the person whose licence has been revoked or whose location has been disallowed or abandoned as the case may be.

Size and Shape of Claim.

Length and breadth of claim.

35. No claim, located for the purpose of mining for gold under a claim licence, shall be more than 1,500 feet long or 800 feet wide.

No claim located for the purpose of searching for precious stones shall be less than 1,500 feet long or 800 feet wide, or shall contain a greater area than 500 acres.

Shape of claim.

36. The side lines and end lines of the surface boundaries of a claim shall as far as possible be run in parallel lines, except where prior locations or natural features prevent this being done, in which case the claim shall be of such shape as may be approved by the Commissioner or by the Warden, subject to the approval of the Commissioner or by a Surveyor making a survey under these Regulations.

Boundaries beneath surface.

37. The boundaries of a claim beneath the surface shall be the vertical planes in which the surface boundaries lie.

PART IV.

Concessions.

Application for concession.

38.—(1) Every application for a Concession under Part II. of the Mining Ordinance, 1903, shall be in writing signed by the applicant, and shall be addressed to the Governor-in-Council and sent through the Commissioner.

(2) The application shall state the name of the person for whose benefit the Concession is sought to be obtained, whether such person is the actual applicant or not, and the term of years for which such Concession is desired.

(3) The application shall also contain a description of the portion of the land, river or creek to which it relates setting forth as far as possible its situation, extent and boundaries, and the applicant shall also, if called upon to do so, furnish such further information as may be required by the Governor for the purpose of determining whether any valid reasons exist why a Concession should not be issued.

(4) The boundaries of every Concession applied for shall be defined by natural features or in accordance with Regulation 30.

(5) The applicant shall on application pay the Commissioner the sum of ten dollars.

(6) Every applicant for a Concession shall on being informed by the Commissioner that his application has been approved by the Governor-in-Council, pay to the Commissioner the first year's rental in advance, and if such rental is not paid within three months of such notification the application may be declared abandoned by the Commissioner by notice in the Gazette for three successive Saturdays and the land referred to therein shall thereupon be open to location by any person.

39.—(1) The Commissioner shall publish a notice of the application in the Gazette for three successive Saturdays and the area comprised within an application shall be deemed to be lawfully occupied within the meaning of these Regulations from the date of such notice. Advertisement and opposition to issue of concession.

(2) During such period any person who desires to oppose the issue of a Concession in accordance with the application, may enter his opposition in writing with the grounds thereof, at the office of the Commissioner in Georgetown.

(3) Every such opposition shall be considered by the Governor-in-Council who may for such purpose require such information from either party as he may think fit.

40. If an opposition is entered and the Governor-in-Council is of opinion that it is well founded, the application shall be refused. Refusal of concession.

41.—(1) If no opposition is entered or any opposition entered is not in the opinion of the Governor-in-Council, well-founded, and the Commissioner reports that a survey is necessary, the Governor may permit such survey to be made by any duly qualified Surveyor or may order such survey to be made by a Surveyor of the Department of Lands and Mines on the estimated cost of survey being deposited with the Commissioner. Survey of concession.

(2) If such estimate is subsequently found to exceed or be less than the actual cost, the difference shall be returned to or paid by the applicant (as the case may be) before the Concession is granted.

42.—(1) If any applicant after being required by the Commissioner On failure of applicant to have survey made, application shall be abandoned.

(*a*) To have such portion of land, river, or creek as is applied for surveyed by a duly qualified Surveyor, or

(*b*) To deposit the estimated cost of survey,

fails for three months to have the necessary survey commenced or to deposit the estimated cost of survey, his application shall be deemed to be abandoned and all fees paid in connection therewith shall be forfeited, and any other application may be proceeded with as if such application had never been made, and notice shall be published by the Commissioner in the Gazette to the effect that the application has been abandoned.

Forfeiture of concession and security.

43. If the holder fails to comply with any of the conditions of his Concession or of any of the Regulations in connection therewith, the Governor-in-Council may cancel the same, and thereupon all the rights thereunder of the holder and all persons claiming under him shall cease and determine and any moneys deposited as aforesaid shall be forfeited and any moneys secured by any bond shall forthwith become due and payable and the holder shall forthwith return the Concession to the Commissioner.

PART V.

Purchase and Transfer of Concessions and Licences.

General right to transfer licences, etc.

44.—(1) The holder of a Concession or Licence shall be entitled to transfer his rights thereunder, either wholly or in part, to any other person in the manner hereinafter provided.

Form No. 8.

(2) On receiving notice of any intended transfer in Form No. 8 in the First Schedule to these Regulations, the Commissioner shall cause the same to be published in the Gazette for three successive Saturdays in order to allow of any opposition to such transfer being entered as hereinafter provided.

(3) Every person desiring to object to such transfer on the ground that he has any right, interest or title in or to the Concession or Licence about to be transferred shall proceed in the manner provided by Regulation 13 as to objections to the issuing of licences.

(4) If any person objects to such transfer on the ground that he is a creditor for a liquidated sum of the person proposing to transfer the same, the Commissioner shall not approve of such transfer until the opposer has had an opportunity of enforcing his claim by legal proceedings: Provided always that if such proceedings are not commenced within one week after the opposition is entered or if within twenty-one days after obtaining judgment in these proceedings a levy has not been made on the Concession or Licence of which the transfer has been opposed, the Commissioner shall no longer withhold his approval:

Provided that nothing in this Regulation shall be construed to give the holder of any Concession, containing any condition forbidding or limiting the right of transfer, any right to transfer in contravention of such condition.

Requisites of purchase and transfer.

45.—(1) If no opposition is entered to an intended transfer or any opposition entered is removed the Commissioner shall record the transfer and shall note on the Concession or Licence the fact of such transfer.

(2) Every transferee shall give in writing to the Commissioner an address in Georgetown to be called a "registered address" at which all notices or other process may be served.

46. On the sale at execution of the holder's rights under a Concession or Licence the purchaser shall, on production to the Commissioner of a copy of the Conditions of Sale signed by the Registrar of British Guiana, or a bailiff as the case may be, with a certificate that the purchase money has been paid, be entitled on payment of the prescribed fee to have an entry made in the register of Concessions and Licences of such sale and purchase and also to receive from the Commissioner a Certificate of Transfer in Form No. 9 in the First Schedule to these Regulations, and such certificate duly signed by the Commissioner shall be evidence in all Courts of Law of the transfer to the purchaser at execution sale of the Concession or Licence therein mentioned. **Sale of concession or licence in execution.** **Form No. 9.**

47. The fee payable to the Commissioner for making the entry and giving the Certificate of Transfer mentioned in the last preceding Regulation, shall be the same as for filing notice of a transfer. **Fees upon transfer.**

48. There shall be payable in advance on every notice of a transfer the fee specified in the Second Schedule to these Regulations. **Fee payable on transfer.**

Lessees and Tributers.

49. No holder of a Concession or Licence shall sub-let the claim in respect of which he holds the Concession or Licence or any part thereof, unless he shall have first obtained the permission in writing of the Commissioner or Warden to do so. **Sub-letting of claims.**

(2) Every person to whom a claim has been sub-let as herein provided, shall be hereinafter referred to as the lessee.

50.—(1) No holder of a Concession or Licence nor any person who leases a claim shall suffer or permit any person other than a person duly registered to serve him as a labourer, to be or to work on such claim on any terms or in any capacity whatsoever, unless such person shall have first obtained a permission hereinafter called a Mining privilege in Form No. 10 in the First Schedule to these Regulations. Every person contravening this Regulation shall be liable to a penalty not exceeding one hundred dollars. **Permission required to be on a mining claim.** **Form No. 10.**

(2) The holder of every such Mining privilege shall be hereinafter termed the tributer.

(3) The holder of a Concession or Licence shall, notwithstanding any such sub-letting or permission be subject to all the obligations imposed on the holders of Concessions or Licences by The Mining Ordinance, 1903, or these Regulations.

(4) Except where it is otherwise to the contrary provided in these Regulations, every lessee or tributer shall without prejudice to the liability of the holder of the Concession or Licence under the preceding sub-clause be deemed to be a joint holder of such Concession or Licence in respect of all obligations imposed on holders of Concessions or Licences by these Regulations.

51.—(1) Every person who desires to work on any claim, in any capacity other than that of a registered labourer, shall apply to the Commissioner or Warden for a Mining privilege in the form hereinbefore mentioned. **Application for mining privilege.**

(2) The Commissioner or Warden may refuse to issue a Mining privilege but where the Commissioner or Warden refuses to do so the applicant may appeal to the Governor whose decision shall be final.

Schedule II.

(3) The fee for each Mining privilege to be paid at the time of application shall be the sum specified in the Second Schedule to these Regulations.

Mining privilege not to exceed twelve months.

52. No Mining privilege shall be issued for a longer period than twelve months.

Claim-holder to endorse mining privilege when tributer arrives.

53. It shall not be lawful for any person in charge of a claim to permit any tributer to be or to work on any such claim until he shall have endorsed on the Mining privilege the date of the arrival of such tributer on the claim and have signed such endorsement.

Mining privilege to be endorsed when tributer leaves claim.

54. If at any time before the expiry of his Mining privilege a tributer desires to leave the claim on which he has been working, the person in charge of such claim shall be bound, on the application of such tributer, to endorse on the Mining privilege the date on which such tributer leaves the claim, and to sign the endorsement so made.

Tributer may work on other claim for unexpired period of mining privilege.

55. The holder of a Mining privilege endorsed in the manner prescribed in the preceding Regulation shall, for the unexpired portion of the time for which such Mining privilege has been issued, be entitled to work on any other claim with the consent of the holder thereof, provided always that it shall not be lawful for any tributer to be or to work on any claim until the person in charge thereof shall have endorsed on the Mining privilege the date of the arrival of such tributer on such claim and signed such endorsement.

Penalty on refusing or neglecting to endorse mining privilege.

56. Every person in charge of a claim who refuses or neglects to endorse a Mining privilege as required under Regulations 53, 54 and 55 shall be guilty of an offence against these Regulations, and on conviction thereof shall be liable to a penalty not exceeding forty-eight dollars, and shall further pay to the holder of such Mining privilege the sum of one dollar for every day during the time he refuses or neglects to endorse such Mining privilege.

Warden may endorse mining privilege.

57. The Warden may at any time during the continuance of a Mining privilege endorse thereon the date on which the holder thereof left the claim on which he was last working, and for the purposes of these Regulations such Mining privilege shall thereupon be deemed to have been endorsed by the person required under these Regulations to endorse the same.

List of tributers to be forwarded to Warden.

58. Every holder of a Concession or Claim Licence or his representative shall at the end of each month forward to the Warden of the District within which his claim is situate, a list in such form approved by the Commissioner, of all tributers who may have worked on the claim during the past month.

Penalty of refusing to leave a claim.

59. Any person refusing to leave any claim when ordered to do so by the holder or person in charge thereof or by any Officer shall be guilty of an offence against these Regulations, and on conviction thereof shall be liable to a penalty not exceeding forty-eight dollars, and shall further pay to the person in charge of such claim the sum of one dollar for every day during which he remains on such claim without the consent of the person in charge thereof.

Officer may order any person to be removed from a claim.

60.—(1) Any Officer may order any person to be summarily removed from any claim, and any person resisting or obstructing the carrying out of any such order may be apprehended without warrant by any Officer, and if so apprehended shall be conveyed as soon as practicable before a Magistrate or Warden to be dealt with according to law.

(2) Every person convicted under this Regulation shall be liable to a penalty not exceeding forty-eight dollars.

61.—(1) Every person who, being at the time on a claim or other land within a mining district, refuses or neglects without reasonable excuse to produce to any Officer when required to do so, a valid prospecting licence or claim licence, or Mining privilege entitling him to work on the land where he is, may be arrested without warrant by or at the instance of any Officer, and if so apprehended shall be conveyed as soon as practicable before a Magistrate or Warden to be dealt with according to law. Penalty on not producing a licence or mining privilege when requested by officer.

(2) Every person convicted under this Regulation shall be liable to a fine of forty-eight dollars.

62. It shall be lawful for the Governor-in-Council to cancel any Licence or Concession if the holder thereof shall knowingly suffer or permit any person to be or to work on such claim in contravention of these Regulations. Licence or concession may be cancelled for breach of above Regulations.

PART VI.

Water Rights.

63. A person may hold at the same time on any one water-course which is not navigable claims extending from the point where such water-course ceases to be navigable to its source. No claim other than a Dredging Concession shall include the bed of a navigable river or water-course. Extent of claims which may be held on water-course.

64. The question whether a water-course is or is not navigable, and at what point a water-course is or is not navigable, shall be determined by the Warden or Commissioner. Determination of navigability of water-course.

65. No person holding a claim on either bank of a navigable water-course shall prevent free navigation and passage thereon. Saving of right of navigation.

66.—(1) Where any water-course passes through or adjacent to any claim the use of the water passing through or along the same shall be subject to any Regulations which may be for the time being in force. Use of water-course passing through or near claim.

(2) Every holder of a claim shall be entitled to the free use of water naturally flowing through or past his claim, and not already lawfully appropriated in such manner as may, in the opinion of the Commissioner or of the Warden, subject to the approval of the Commissioner, be necessary for the proper working thereof.

67. No person shall back the water of any river, creek, or water-course upon any claim or cause any claim to be flooded, either wilfully or by neglect, through the construction of any dam or stop-off, or in any other way. Prohibition of flooding of claim.

68. The Governor may grant to any person a licence, with such terms and conditions as he may think proper,— Licence for construction of dam, etc.

(1) To construct and use any dam, reservoir or water-race, or lay down pipes for the conveyance of water or erect any wire or land

cable for the purpose of conveying electricity, and to erect and use pumping or other machinery in connection therewith, through or upon any Crown Lands for the purpose of working any claim, and

(2) To take, direct and use any water from any river, creek, tributary, stream, lake, or pool situated upon or flowing through any Crown Lands for the purpose of supplying with water any machine or any engine or machinery employed in extracting gold by crushing or any other process, and for mining purposes generally: Provided that such works shall not interfere with any existing rights.

Rules as to construction of dam, etc., on lands occupied by claim-holder or vacant.

69.—(1) The construction of a dam, reservoir, water-race, the laying of pipes for the conveyance of water or erection of any wire or land cable for the conveyance of electricity, or the erection of pumping or other machinery in connection therewith, shall be commenced within such time as the Commissioner may consider reasonable from the issue of the licence authorising the same, and the holder of the licence shall continue such work until it is completed to the satisfaction of the Commissioner or Warden; otherwise any superiority of right which he may be entitled to by virtue of such licence, may be declared by the Governor to be forfeited.

(2) Every water-race shall have a point, to be specified by the Commissioner or Warden, at which it shall be taken from the river, creek, or other source, but in no case shall such river, creek, or other source be included in or form part of any water-race or pipe for the conveyance of water

(3) Any licensee of a water-race who leads the same across any road or thoroughfare shall construct and keep in repair suitable crossings, to the satisfaction of the Commissioner or Warden.

Construction of dams, etc., on lands not occupied by the claim-holder.

70. The Commissioner may, on the written application of the holder of any claim, require the holder of any other claim to cut and construct on his claim or permit the holder of the first-mentioned claim to cut, construct and use thereon, to the satisfaction of the Commissioner or Warden, any of the works mentioned in Regulation 68 which may be necessary for the proper working of the first-mentioned claim: Provided always that the holder of the claim on which such work is constructed shall be entitled to receive from the owner of the other claim such compensation (if any) as the Commissioner or Warden may award.

71. The Commissioner, on the written application of the owner of any dredge or his representative, may permit such dredge to be taken from one part of a Creek to any other part thereof across any Claim or Claims held by other persons: Provided always that the holders of such Claims across which any dredge is permitted to pass shall be entitled to receive from the owner of the dredge such compensation (if any) as the Commissioner or Warden may award.

Right to use of channel of river or creek.

72. The natural channel of the river or creek shall be considered as a public tail-race, and all claim-holders shall be entitled to, and if required by a Warden shall turn their tail water into the river or creek at the end of their claims.

Prohibition of damage to race, etc.

73. No person shall, under any pretence whatever, damage, destroy, or otherwise interfere with any race, tail-race, dam, sludge channel, or draining machine or other appliance connected therewith, or with any claim or area, unless the same has been abandoned or the sanction of the owner thereof, or the authority of the Warden has first been obtained in writing for that purpose.

74. In case any holder of a licence under Regulation 68 fails to make a reasonable use of the advantages allowed to him by his licence or if he takes water in excess of a reasonable quantity or if he wastes water or if he fails to comply with the condition under which his licence was granted, the Governor may cancel his licence. Power to cancel licence.

75. No person shall deposit or cause to be deposited upon any claim or site in the occupation of any other person except with the consent of such person, any earth, stone, gravel, debris, or tailings or any other substance. Protection of claim-holder from deposit of earth, etc.

Timber Rights.

76.—(1) The holder of a claim shall have the right to use all timber growing on his claim as he may require for the proper working of such claim, subject however to the rights reserved under Regulation 15. Right to use trees on claim.

(2) The holder of a Concession or Licence who may require any wood, timber, or other material from the ungranted Crown Lands, outside the limits of his claim, for the purposes set forth in these Regulations, may apply for and take out a licence or licences for the same under the Crown Lands Regulations for the time being in force, and any application made under this Regulation shall have preference over any other application for a licence made under the Crown Lands Regulations.

77.—(1) The holder of any Dredging Concession may on payment of an annual rent of ten cents an acre to the Commissioner and subject to such conditions and restrictions as may, from time to time, be imposed by the Governor-in-Council, cut any timber and fuel on such parts of the banks of the rivers or creeks contiguous to his claim and to a depth of not more than 150 feet in from the banks thereof, as are not owned, or under the Crown Lands Regulations or under these Regulations legally occupied by any other person, provided such timber or fuel is required solely for the purpose of the dredging operations for which the Concession has been granted. The land comprised within the said space of 150 feet shall be deemed to be lawfully occupied within the meaning of these Regulations and shall not be open to location by any person. Right of holder of dredging concession to cut timber.

(2) The holder of a Dredging Concession who may desire to cut and use wood, timber or other material from the ungranted Crown Lands outside a depth of 150 feet from the banks of the portion of river or creek which has been granted to him for the purposes set forth in these Regulations may apply for a licence or licences for the same under the Crown Lands Regulations for the time being in force, and any such application made under this Regulation shall have preference over any other application for a licence made under the Crown Lands Regulations.

78. Any person who fells or causes to be felled any tree across or upon any road, foot-path, crossing-place, claim, water-race, or other mining property shall cause the same to be removed within twelve hours after the felling thereof. Removal of tree felled on road, etc.

Occupation of Land for Residences, Mills, etc.

Occupation for specified purposes of land in vicinity.

79. The Commissioner may, on such terms and conditions as he thinks fit, permit any holder of a Concession or Licence to occupy a portion of Crown Land in the vicinity of his claim for the purpose of erecting thereon a residence for himself or persons in his employ or any mill, or any work or building required for mining purposes or for any business or other legitimate object connected with mining, provided that such land is not required for mining purposes or the occupation thereof calculated in any way to interfere prejudicially with mining operations.

Permission to construct railway or tramway.

80. The Commissioner may, on such terms and conditions as he thinks fit, permit the holder of a Concession or Licence to construct and maintain a railway or tramway on any portion of Crown Land leading to or from his claim, which may be necessary or desirable for the better and more effectual working of such claim, and the Commissioner may also permit such railway or tramway to be carried across the claim of any other person, provided that such railway or tramway does not interfere with, or prevent the proper working of the claim of such last-mentioned person, and provided further that such compensation as the Commissioner shall think just and reasonable, shall be paid to such last-mentioned person by the person who desires to carry any railway or tramway across such last-mentioned claim, and any dispute as to the amount of such compensation or in connection with the carrying of any such railway or tramway across the claim of any person, shall be determined under the provisions of Part XI. of these Regulations.

Path or Trail.

Right of user of path or trail when cut.

81. Where the holder of a prospecting licence cuts a path or trail through the forest, he shall be entitled to the exclusive use thereof for a period of three months from the time when he began such path or trail : Provided that, in order to acquire and hold the right conferred by this Regulation, such holder shall on beginning such path or trail post a notice in a conspicuous place on a tree, corner post, or beacon at the commencement of the path or trail, in the presence of two witnesses, in which notice there shall be stated the name of such holder and the date on which the path or trail was begun : Provided also, that such holder shall forthwith notify to the Commissioner, or Warden in writing the particulars relating to the path or trail :

Provided further that an Officer on public business may at any time make use of such path or trail.

Protection of right.

82. Every person, other than the person cutting such path or trail, who uses any portion of the path or trail before the expiration of the said period, after such cutting has been begun and subsequently locates a claim on any ground to which he travelled by such portion of the path or trail without the permission of the person cutting the same, shall forfeit all right to such claim, and possession may be taken of such claim under Regulation 93 by the person cutting such path.

Determination of question of right.

83. Where any question arises as to whether any person has travelled to any ground located by him by or along a portion of the path or trail cut by another person, without permission as aforesaid, before the expiration of the said period, the question shall be determined by the Commissioner or Warden, and the procedure provided in Part XI. of these Regulations shall be adopted in such cases.

Surveys of Claims.

84.—(1) The holder of a claim who desires to have the same surveyed by a Government Surveyor shall defray the costs of the survey. Defraying of costs of survey.

(2) Application for the survey shall be made to the Commissioner or Warden and the necessary fees and costs shall be paid in advance.

(3) The costs of a survey of a claim in dispute shall be defrayed in the first instance by the person applying to have the dispute determined, and the Officer determining the same shall have power to say on whom the costs shall fall, and the same shall be recoverable as costs in the cause.

85. Where the Commissioner or Warden considers it necessary that a survey should be made to prevent dispute or error, he shall cause an intimation to that effect to be given to any holder of a claim, and thereupon the holder shall be bound, at his own expense, to furnish to the Surveyor all necessary labour, but shall not be liable for the payment of any fees. Power to commissioner to direct survey.

86.—(1) On making a survey, the Surveyor may modify or alter the boundaries of a claim, so as to make the claim conform to these Regulations, or so as to avoid interference with the rights and privileges of persons other than the holder of the claim. Modification of boundaries on survey.

(2) In such case the diagram shall show the boundaries as marked out by the holder of the claim and the boundaries which the Surveyor lays down by way of modification or alteration.

87. The fees for any survey shall be according to the scale laid down in the Second Schedule to these Regulations. Fees payable for survey.

Survey of Dredging Concessions.

88.—(1) Subject to the provisions of Regulation 89 no Dredging Concession shall be granted unless the portion of the river or creek to be granted has been surveyed by a duly qualified Surveyor. Dredging concession not to be granted till survey made.

(2) If any such survey is not made by a Surveyor of the Department of Lands and Mines the original diagram of such survey together with a duplicate of the same shall be delivered to the Commissioner.

89.—(1) No survey of any portion of a river or creek in respect of which an application has been made, shall be necessary if such portion of river or creek has been previously granted, and any duly qualified Surveyor is able from personal knowledge to certify that the boundary paals are in good order and are to the best of his belief standing in their original positions, and in such cases the applicant shall obtain from the Department of Lands and Mines a certified copy of the diagram on record in that Department together with a certificate of the Surveyor who had inspected the boundaries. Survey not necessary in certain cases.

(2) No survey shall be necessary if the portion of the river or creek applied for is bounded by tributary creeks or other well defined limits and such boundaries are well marked on a chart of a survey on

record in the Department of Lands and Mines from which it is possible to calculate accurately the area of the portion of the river or creek applied for.

Area of concession.

90. The width of a river or creek for the purposes of calculating its area shall be taken from the top of one bank to the top of the other bank, as fixed by the survey.

Boundary marks.

91. The Surveyor, at the cost of the applicant, shall place at each extremity of the granted portion of a river or creek on each bank thereof, iron or concrete paals.

Position of boundary lines.

92. The boundary lines defining the limits of length of any portion of river or creek to be granted shall run across such river or creek at right angles to its course at the point where such boundary lines are fixed.

Jumping of Claim.

Cases in which jumping is allowed.

93.—(1) A claim for which a licence has not been issued may be jumped under the following circumstances only :—

(*a*) If the person locating it had no prospecting licence in force at the time ; or trespassed on another person's path or trail in order to locate it under Regulation 82 ;

(*b*) If the person locating it has included therein a greater area than is allowed by these Regulations : Provided always that in any such case the claim to jump shall be disallowed, if the Officer who tries the case finds that the excess in size is small, and that there is no intention to deceive or defraud on the part of the locator ;

(*c*) If with intent to deceive or to defraud other prospectors, or claim-holders, or the Government, the person locating it does not comply with Regulation 30 ;

(*d*) If notice of location has not been given as required by Regulation 7 ;

(*e*) If the boundaries of the claim are not marked and kept marked as required by these Regulations.

(2) A claim for which a licence has been issued may be jumped under the following circumstances only :—

(*a*) If the boundaries of the claim are not kept marked as required by these Regulations ;

(*b*) If the person locating it has included therein a greater area than is allowed by these Regulations : Provided always that in any case the claim to jump shall be disallowed if the Officer who tries the case finds that the excess in size is small, and that there is no intention to deceive or defraud on the part of the locator.

(3) No person who is not the holder of a Prospecting Licence, or authority in accordance with Regulation 6, may jump a claim.

(4) This Regulation shall not apply to claims in respect of which concessions have been granted. Such claims cannot be jumped.

Proceedings in cases of jumping.

94.—(1) If any person asserts a right to jump a claim located or held by any other person he shall clearly define in his notice of jumping the land which he asserts the right to jump and shall refrain from locating the same and without delay give notice in writing to the Commissioner or Warden, and also to the holder of the claim or his representative that he asserts the right to jump the claim.

(2) In the notice the person asserting the right to jump shall state the reasons upon which he founds his right.

(3) The person asserting the right to jump shall be regarded as the complainant in the case, and the person whose claim is jumped shall be deemed to be the opposite party within the meaning of that term as used in Part XI. of these Regulations.

(4) The complainant shall, when he gives the notice hereinbefore required, deposit with the Commissioner or Warden a sum of twenty-five dollars to meet costs and expenses, such sum to be dealt with as the Officer who tries the case may determine.

(5) If either party interested so desires and deposits a sum sufficient to cover the expenses of such visit and inspection, the Officer who tries the case shall visit and inspect the claim in dispute before giving his decision. The Officer shall have power to say on whom the expenses shall fall and the amount thereof, and the same shall be recoverable as costs.

(6) Pending a final decision, the complainant shall in no way interfere with the claim in dispute, and shall not take possession thereof; but the Officer who tries the case may order all work to cease on the claim, until the dispute is decided.

(7) The notice in writing hereinbefore required shall be deemed a complaint, and the provisions with respect to the determination of disputes contained in Part XI. of these Regulations shall, so far as they are appropriate thereto, apply to the determination of any application to jump a claim.

(8) Costs may be awarded by the Officer who tries the case against a person asserting a right to jump a claim, if such jumping is decided to have been based on frivolous grounds.

(9) In the event of the claim being awarded to the jumper he shall be entitled to receive from the Commissioner on payment of the prescribed fee a licence for the claim in question and the licence originally issued shall become null and void.

Keeping of Record of Gold and Precious Stones.

Book to be kept on claim showing gold, etc., obtained.

95.—(1) Every holder or lessee of a claim who employs registered labourers to work on such claim shall cause to be recorded in a book, to be kept on the claim, having pages consecutively numbered approved by the Commissioner, and bearing the Government stamp and number, a correct account of all gold or precious stones obtained on the claim.

(2) The account shall be written up daily, and on any day on which gold or precious stones are not obtained, an entry to that effect shall be made.

(3) Every such book shall at all times be open to the inspection of any Officer.

Claim-holder to keep book showing gold, etc., received from tributer.

96. Every holder or lessee of a claim on which tributers are permitted to work in consideration of paying to such holder or lessee any portion of the gold or precious stones obtained therefrom shall, on receiving any payment in kind from any such tributer, enter in the Register referred to in Regulation 95,

(*a*) The weight of all gold or precious stones received from such tributer.

(*b*) The name of such tributer and the number and date of his Mining privilege, together with the number of every receipt given to such tributer as hereinafter provided.

Tributer to keep book showing gold, etc., paid to claim-holder. Form No. 11.

97. Every tributer who works on any claim in consideration of paying as tribute to the holder or person in charge thereof any portion of the gold or precious stones obtained therefrom, shall keep a receipt book in the Form No. 11 in the First Schedule to these Regulations having pages consecutively numbered and bearing the Government stamp and number, and shall for every payment in kind made by him as hereinbefore provided, obtain a receipt in such Receipt Book signed and dated by the holder or person in charge of such claim, who is hereby required to sign and date the same.

(*a*) Every person who neglects to keep such book, or alters or otherwise defaces the same, shall be guilty of an offence against these Regulations.

(*b*) Such book shall be at all times open to the inspection of any Officer.

Power for officer to require production of gold.

98. An Officer may at any time require the holder or lessee of a claim as aforesaid or his representative to produce all gold or precious stones then being on such claim whether obtained from working such claim or otherwise, for the purpose of enabling such Officer to compare the quantity with the books; and such Officer may search a claim and every part thereof, and every person thereon, if he has reason to believe that any such gold or precious stones has not been produced.

Penalty for not keeping book, etc.

99. The holder or lessee of any claim or his representative as aforesaid, or any person in charge of a claim who—

(1) Fails to comply with the provisions hereinbefore contained as to the keeping and use of a book on the claim ; or

(2) Refuses or neglects to allow any Officer to inspect such book ; or

(3) Refuses or neglects to produce any gold or precious stones when required by an Officer to do so

shall for each offence be guilty of a breach of these Regulations.

PART VII.

Employment of Persons in Mining Districts.

Power to employ labourers.

100. The holder of a Concession under Part II. or of a Licence under Part III. of The Mining Ordinance, 1903, may employ such number of labourers to assist him as he may require. No labourer shall be deemed to be employed by such holder as aforesaid unless he is actually working under the supervision and control of such holder or of some person authorised by such holder in the locality where the operations under such Concession or Licence are actually being carried on.

General rule as to registration of labourers.

101. It shall not be lawful for the holder of any claim to employ, suffer or permit any labourer, other than an Aboriginal Indian, to be employed or work in any capacity thereon until such labourer has been registered to work for him on such claim.

102. No company or co-partnership whether duly registered in this Colony or not shall be allowed to register labourers to work in any capacity in any mining district otherwise than in the name of an individual resident in the Colony who must be the duly authorised attorney or representative of the said company or co-partnership and who shall be held personally and individually liable for all the liabilities imposed by these Regulations upon an employer of labour.

103.—(1) Every person who— Penalty for violating provisions relating to registration.

(*a*) Works as a labourer in any Mining District without being duly registered; or

(*b*) Being at the time on any claim, refuses or neglects, without reasonable excuse, to produce to any Officer when required to do so, a valid certificate of registration to work on the claim where he is,

may be apprehended by any Officer without warrant, and if so apprehended shall be conveyed as soon as practicable before a Magistrate or Warden to be dealt with according to law.

(2) Every person convicted under this Regulation shall be liable to a penalty of forty-eight dollars.

104. Application for the registration of labourers shall be made in Georgetown or in any Mining District at such places as may from time to time be fixed by the Governor, to the Institute of Mines and Forests or some agent or officer thereof, which said Institute and its agents or officers are hereinafter referred to as the Registering Officer. Making of application for registration.

105.—(1) Where any labourer is registered to work on any claim and the contract between him and his employer is for a limited time it shall not be necessary on the expiration of the term of service if such labourer desires to remain on such claim to again register such person, but in any such case the employer shall endorse the expired certificate of registration to the effect that the labourer's term of service has been extended for a period which must be stated, and notice shall as soon as practicable be sent to the Registering Officer of such continuation of service. Renewal of contract without registration.

(2) Every labourer whose certificate has not been endorsed as hereinbefore provided who works on a claim after the expiry of his term of service, shall be deemed to have been employed thereon by the holder thereof without being duly registered, as required by these Regulations.

106.—(1) Any labourer who absconds or absents himself from the service of his employer and who works on, or is found on, any claim or other land within a Mining District, may be apprehended without warrant by any Officer, and if so apprehended shall be conveyed as soon as practicable before a Magistrate or Warden to be dealt with according to law. Apprehension of absconder.

(2) Every person convicted under this Regulation shall be liable to a penalty not exceeding forty-eight dollars.

107. Where any labourer is convicted under the preceding Regulation, the Magistrate or Warden trying the case may order that any sum owing by such labourer to his employer on account of advances or otherwise shall be deducted from the fine imposed on such labourer and be paid to the employer. Deduction of amount owed employer from fine.

Power to refuse registration.

108. The Registering Officer may refuse to register labourers for any employer against whom any unsatisfied judgment for labourers' wages exists and shall not register any labourer whose contract with another employer is unexpired and still subsisting, except with the permission of such employer.

Certificate of registration. Form No. 12.

109. The Registering Officer shall give every labourer registered a certificate on parchment, in the Form No. 12 in the First Schedule to these Regulations.

Fee payable for registration. Second Schedule.

110. The fee for registering each labourer, to be paid at the time of registration, for the benefit of the said Institute, shall be the sum specified in the Second Schedule to these Regulations.

Registration of discharged labourer.

111. It shall not be necessary for any labourer who has been duly registered whose period of service has expired and who is in any Mining District, and who desires to be employed on any claim other than the one in respect of which he has been registered, to attend personally before the Registering Officer, but it shall be sufficient if the application for registration is made by letter sent by post, enclosing the fee for such registration, and the certificate referred to in Regulation 114 and in such case the Registering Officer shall forward the certificate by post.

Restriction as to registration of East Indian immigrant.

112. No East Indian Immigrant shall be registered unless he produces his certificate of exemption from labour.

Keeping of record of persons registered.

113. The Registering Officer shall keep a record of the names, ages, residences, places, and terms of employment and proposed wages and of such other particulars, as the Governor may direct, and shall supply the Commissioner free of charge with such information as he may, from time to time, require.

Certificate of completion of contract. Form No. 13.

114. Every holder or person in charge of a claim shall be bound to give a labourer, on the completion of his contract, a certificate in the Form No. 13 in the First Schedule to these Regulations to the effect that he has completed his service under the contract, and the said certificate may be endorsed on the Certificate of Registration.

Register of Servants employed.

Keeping of register of persons employed on claim.

115.—(1) The holder or person in charge of every claim who employs registered labourers on such claim shall be bound to keep thereon a book, in which shall be recorded—

(*a*) The name of every servant employed on the claim ;
(*b*) The number of his registration certificate ;
(*c*) The date of his arrival on the claim ;
(*d*) The date of his leaving the claim, the cause, and when possible the place to which he has gone ; and
(*e*) In case of death, the date of death, the cause of death so far as can be ascertained, and the place of burial and the wages due such servant at the time of his death.

(2) Every such book shall at all times be open to the inspection of any Officer.

Keeping of register of tributers.

116. The holder or lessee or other person in charge of a claim on which tributers are permitted to work, shall keep thereon or at such place as may be approved by the Commissioner a book in which shall be recorded,

(*a*) The name of every such tributer and the number of his Mining privilege;
(*b*) The date of his arrival on the claim or concession;
(*c*) The date of his departure and when possible the place to which he has gone; and
(*d*) In case of death, the date so far as can be ascertained and the place of burial. Every such book shall at all times be open to the inspection of any Officer.

117.—(1) Every holder of a claim who employs Aboriginal Indians on such claim shall keep on the claim a separate book in which shall be recorded the name of every such Indian, the amount of wages earned by him, daily or weekly as the case may be, and the manner in which he is paid, whether in cash or otherwise. **Employment of Aboriginal Indians.**

(2) Every such book shall at all times be open to the inspection of the Protector of Indians or any Officer.

Payment of Wages.

118.—(1) Subject to the provisions hereinafter contained with respect to Aboriginal Indians, all wages due to any servant employed on a claim shall be paid to him in cash, except deductions for advances, for payments on orders given by the servant, for goods supplied on the claim to the servant for his personal use to a value not exceeding five dollars in any one month, or for fines imposed under these Regulations. **Mode of payment of wages.**

(2) Every person who employs labourers to work for him on or in connection with any claim shall pay all wages due to such labourers immediately the same become due, and any such employer failing to pay such wages within fourteen days of the same becoming due shall be deemed guilty of a breach of these Regulations, and, on conviction thereof, shall be liable to a penalty not exceeding fifty dollars.

(3) It shall be no defence to a complaint made under sub-section (2) hereof, that the employer had given an order on any other person for the payment of such wages.

(4) A complaint for an offence under sub-section (2) hereof, may be prosecuted in the judicial district where the servant was engaged.

(5) Nothing herein contained shall affect any proceeding for enforcing the payment of any wages due by any employer to his servants.

(6) In no case under this section shall any complaint be entertained or a summons issued in pursuance thereof unless a certificate in writing, signed by the Registering Officer of the District in which the said servant was engaged, be annexed thereto, to the effect that such complaint is based on reasonable grounds.

119. When a servant on a claim desires to receive his wages at the end of each week or month or other period agreed upon, at the place of working or some convenient place near thereto, and such desire is expressed in any contract in writing to work on a claim, he shall be paid accordingly. **Special contract as to time and place of payment.**

Payment of Aboriginal Indian.

120.—(1) An Aboriginal Indian employed on a claim shall except with the express permission in writing to the contrary of the Protector of Indians or of the Commissioner or Warden, be paid his wages in cash, without any deduction or abatement, and such payment shall be made at the place of working or some convenient place near thereto, and nowhere else.

(2) A permission given under this Regulation may be either special or general.

Keeping on claim of book relating to wages.

121.—(1) The holder of every claim shall keep thereon a book showing, in the case of each labourer, the rate of wages, the amount earned according to contract, and the deductions, and shall, on application, furnish the labourer, on the completion of his contract, with an account properly certified by him or on his behalf by the person in charge of the claim showing the amount the labourer has earned, the advances received, goods had, fines imposed, and the balance due to the labourer.

(2) Every such book shall at all times be open to the inspection of any Officer.

Penalty for failure to comply with regulations as to wages.

122. Every holder of a claim or his representative who refuses or neglects to comply with the provisions of these Regulations relating to the payment of wages shall be liable to a penalty not exceeding fifty dollars.

Wages of deceased employé.

123. On the death on a claim of any servant, the amount due to him shall forthwith be paid by the employer to the heirs unless otherwise directed by the deceased.

Power to manager to fine labourer.

124.—(1) It shall be lawful for the person in charge of a claim to impose fines on labourers for misconduct committed on the claim : Provided always that the amount of the fine, which shall in no one case exceed one dollar, and the misconduct for which it was imposed, shall be without delay recorded by the person in charge of the claim in the book required to be kept under Regulation 121 and the entry dated and signed by him, after being read over to the labourer.

(2) Any fines so imposed shall be deducted from the labourer's wages.

(3) A labourer may appeal against any such fine to the Warden, or to the Commissioner who shall refer the same to the Warden and the Warden shall endorse his decision, which shall be final, on the labourer's account.

Duties of Employers.

Keeping of medicine, etc., on claim.

125.—(1) Every person who employs any servant on a claim shall be bound to keep thereon such medicines and medical remedies as may for the time being be required by the Governor to be so kept by notice published in the Gazette and in a newspaper circulating in the Colony ; and where fifty servants or more are employed on such claim shall employ a certificated sick nurse and dispenser on such claim, provided there is no Government Hospital or Dispensary within ten miles thereof, and shall also be bound in addition to the payment of the wages agreed upon, to feed every such servant or to furnish every such servant so employed with sufficient rations, in accordance with a scale for the time being approved by the Commissioner.

(2) No servant shall be convicted or punished in respect of any breach of contract for not working on a claim if he proves that the requirements of this Regulation have not been complied with.

126. Where any servant is ill on a claim or on his way to or from such claim, an Officer may require the person in charge of the claim to send, or may himself send such sick servant to the nearest hospital or dispensary for medical or surgical treatment, and may recover from the owner or the person in charge of the claim, any expense incurred by such Officer in so sending such sick servant, and also any sum owing to such sick servant at the time he is so sent to the hospital or dispensary, and after deducting therefrom the sum of twenty-five cents for each day's maintenance in hospital and funeral expenses in case of death, shall pay over the residue to such sick servant on his leaving such hospital or dispensary, or on his death to his heirs unless otherwise directed by the deceased. Sending of sick servant to hospital.

Every holder or person in charge of a claim shall, when any sick servant is so sent as aforesaid to a hospital or dispensary, send with him a statement of his account showing the sum owing to him at that date, and shall on application furnish the Officer with any information needed for verifying the accuracy of such account.

127. Where any servant who has been engaged to work on a claim for a limited time desires, on the expiration of such time, to leave the claim, the holder of the claim shall, within a reasonable time thereafter, provide the means but not the cost of conveyance, to the place where such servant was engaged, and in the meantime whilst such servant continues on the claim, shall feed or supply such servant with rations in accordance with Regulation 125. Sending down of time-expired servant.

128.—(1) In the event of a death occurring on any claim, the person in charge shall, by the first opportunity, report the fact in writing to the Warden, stating the particulars required to be recorded by Regulations 115 or 116. Procedure in respect of death on claim.

(2) The Warden shall forward a copy of such particulars as soon as possible to the Commissioner, with such further information and remarks as he may think necessary.

129.—(1) In the event of the death of any servant engaged to work on a claim occurring either in going to or coming from the claim, the holder or person in charge of the claim shall, as soon as such death comes to his notice, report the fact to the Warden, and shall also bury the corpse, or if such corpse has been buried by any other person, deposit with the Warden for payment to the person who has buried the same the sum of ten shillings. Procedure in respect of death on way to or from claim.

(2) In the event of the death of any such servant occurring on any river or creek before he arrives at his destination, the steersman or other person in charge of the boat in which such servant is carried, shall be bound to report the fact to the nearest Warden and to bury the corpse.

(3) If default is made by any person in burying a corpse in accordance with this Regulation, such corpse may be buried by any person, and the cost of so doing may be recovered by such person from the person making such default.

PART VIII.

Conveyance of Gold.

Restriction as to right to convey gold.

130. No person who is not the holder or person in charge of a claim, or who is not authorised by the holder or person in charge of a claim in writing for that purpose shall convey gold from a claim or obtain a permit to convey gold from a claim to Georgetown.

Mode of conveying gold.

131. The mode of conveying gold from a claim to Georgetown, except in cases where the gold has been sold under Regulation 146 and unless the Commissioner has directed otherwise, shall be as follows :—

(1) The holder or person in charge of the claim, or the person authorised in writing as provided by Regulation 130 for that purpose, shall, on leaving the claim, take with him a copy of the record book of gold kept on the claim, made up to the last day when gold was obtained, and showing the amount of gold in his possession, certified as correct by the holder or person in charge of the claim ;

(2) On arrival at the Station nearest to the claim on which the gold was obtained, the authority to convey the gold, if any, the certified copy of the record book, and all gold in the possession of the person arriving at the Station shall be delivered to the Officer in charge of the Station, in a strong tin or wooden box, or other receptacle approved by the Officer, who shall immediately weigh the gold ;

(3) The box or other receptacle shall then be fastened by the Officer with string or tape, the ends being securely sealed with wax and a seal, in such manner that the same cannot be opened without interfering with the fastening ; and

Form No. 14.

(4) A permit, in the Form No. 14 in the First Schedule to these Regulations, shall then be made out in triplicate by the Officer ; one copy shall be delivered to the person in charge of the gold, another copy shall be securely fastened to the box or other receptacle, and the third copy, together with the certified copy of the record book, shall be forwarded by the first opportunity by the Officer in a sealed envelope to the Commissioner.

Case of less gold received than stated in permit.

132. If, on its arrival in Georgetown, the box or other receptacle is found to contain a less quantity of gold than is stated in the permit, the owner shall nevertheless pay royalty on the full quantity of gold so stated ; but if the permit is absent or is altered or defaced, the box or other receptacle and its contents may be detained by the Commissioner until inquiry has been fully made into the matter, and the Commissioner has decided on what quantity royalty shall be paid.

Payment of Royalty on Gold.

Disposal of gold and payment of royalty.

133. Every person who conveys gold to Georgetown shall, within twenty-four hours after arrival, days on which the Office of the Commissioner is closed excepted, lodge the same at the Office of the Commissioner, and on production of the permit, an Officer of the Department of Lands and Mines shall certify the amount of royalty to be paid, and such amount shall thereupon be paid to the Receiver General.

134. On payment of the royalty, the Receiver General shall give a receipt therefor, and such receipt shall entitle the person who lodged the gold to receive the same, unless it is detained as hereinafter provided, and the gold so lodged shall not, unless so ordered by any Court of competent jurisdiction, be given up to any person other than the person who lodged the same. Effect of receipt for royalty.

Conveyance of Precious Stones.

135. It shall not be lawful for any person to convey precious stones from any Mining District to Georgetown, or to any place outside the Mining District within which they were found without a permit from the Officer in charge of the nearest Station. Permit required for removal of precious stones.

136. Except as is provided by Regulation 26, no person who is not the holder or person in charge of a claim, or who is not authorised by the holder or person in charge of a claim in writing for that purpose, shall obtain a permit to convey precious stones from such claim to Georgetown. Restriction as to right to convey precious stones.

137. In order to obtain a permit for the conveyance of precious stones :— Permit for conveyance of precious stones.

(1) The holder or person in charge of the claim, or the person authorised in writing as provided by Regulation 136 for that purpose, shall, on leaving the claim, take with him a copy of the record book of precious stones kept on the claim, made up to the last day when precious stones were obtained, and showing the amount of precious stones in his possession, certified as correct by the holder or person in charge of the claim ;

(2) On arrival at the Station nearest to the claim on which the precious stones were obtained, the authority to convey the precious stones, if any, the certified copy of the record book, and all precious stones in the possession of the person passing the Station shall be delivered to the Officer in charge of the Station, accompanied by a statement signed by the holder or person in charge of the claim of the number and weight of the precious stones for which a permit is required.

(3) A permit in the Form No. 14 in the First Schedule to these Regulations, shall then be made out in triplicate by the Officer ; one copy shall be delivered to the person in charge of the precious stones, one copy shall be retained by the Officer, and the third copy with the certified copy of the record book shall be forwarded by the Officer to the Commissioner. Form No. 14.

Detention of Gold and Precious Stones.

138.—(1) The Commissioner or any Officer to whom gold or precious stones are brought under these Regulations may, if he has reasonable cause to suspect that such gold or precious stones have been obtained from land not located or for working which the rent payable has not been paid or that such gold or precious stones have been stolen, or are not the property of the person bringing them, or on whose behalf they are brought, detain the same, and, if any Officer other than the Commissioner, forward them to the Commissioner, in charge of some responsible person, together with a report explaining the reasons for detention. Detention of gold or stones suspected to be improperly obtained.

(2) The Commissioner shall, on the receipt of the gold or precious stones make such inquiries and take such action in respect of the same as he may think fit.

(3) All expenses incurred in forwarding the gold or precious stones shall be a charge thereon, and the same shall not be delivered up by the Commissioner until such expenses have been repaid.

Delivery up of gold or stones detained.

139. Any gold or precious stones detained under these Regulations may be delivered up to any person, if the Commissioner thinks fit, on sufficient security being given by, or on behalf of such person to cover the value thereof.

Sale and Purchase of Gold or Precious Stones.

Restriction on sale of gold. Form No. 15.

140. No person other than the holder of a claim or his agent duly authorised by him in writing in Form No. 15 in the First Schedule to these Regulations, or a tributer working on a claim or a person holding a licence to trade in gold, shall sell any gold: Provided that any gold obtained during prospection may be sold by the holder of the prospecting licence to any person holding a licence to trade in gold.

Restriction on sale of precious stones. Form No. 15.

141. No person other than the holder of a claim or his agent duly authorised by him in writing in Form No. 15 in the First Schedule to these Regulations or tributer working on a claim or a person licensed to trade in precious stones, or the holder of a receipt for the royalty payable under Regulation 26, shall sell any precious stones.

Restriction on purchase of gold or precious stones.

142. No person with the exception of the holder of a licence to trade in gold or precious stones shall purchase any gold or precious stones except from a person holding a licence to trade in gold or precious stones.

Gold not to be sold until royalty paid.

143. Subject to the provisions of Regulation 146 no licensed trader in gold shall purchase any gold without the production of the receipt for the royalty payable thereon.

Precious stones not to be sold without permit.

144. Subject to the provisions of Regulation 146 no licensed trader in precious stones shall purchase any precious stones without the production of the permit mentioned in Regulation 137, or the receipt for royalty payable under Regulation 26.

Keeping of books by licensed trader in gold and precious stones.

145.—(1) The holder of a licence to trade in gold or precious stones shall be bound to keep a book in the form approved by the Commissioner in which shall be recorded :—

(*a*) The name of every person from whom he buys any gold or precious stones.

(*b*) The number and date of the licence, Mining privilege or concession of the person from whom such gold or precious stones are bought and where such gold or precious stones is or are bought from a tributer, the name of the holder of the licence for the claim from which such gold or precious stones were obtained together with the number and date of the receipt given for such gold or precious stones.

(*c*) The date on which such gold or precious stones is or are purchased ; and (*d*) A correct account of the weight of such gold or precious stones.

(2) Every such books shall at all times be open to the inspection of any Officer.

146.—(1) Any holder or lessee of a claim or his agent duly authorised by him in writing for that purpose in Form No. 15 in the First Schedule to these Regulations or any tributer may sell any gold or precious stones obtained from his claim to any person holding a licence to purchase gold or precious stones in the Mining District: Provided that any lessee or tributer who sells any gold to any person other than the holder of the claim from which it was obtained or his agent, shall notify the fact of such sale to such claim holder or his agent. **Sale of gold or stones in district. Form No.**

(2) Every person authorised as aforesaid to sell gold or precious stones to a person holding a licence to purchase gold or precious stones, shall keep a receipt book in the Form No. 16 in the First Schedule to these Regulations, having pages consecutively numbered and bearing the Government stamp and number, and shall for every parcel of gold or precious stones sold by him obtain a receipt in such book which shall be filled up, signed and dated by the person purchasing such gold or precious stones, who is hereby required to fill up, sign and date such receipt. Such book shall be open at all times to inspection by any Officer. **Form No. 16.**

(3) Every person who neglects to keep such book or alters or defaces or destroys the same, shall be guilty of an offence against these Regulations.

(4) Every person holding a licence to purchase gold or precious stones, shall, at convenient intervals, but in no case less than once in every month, except with the permission of the Warden, forward to the nearest Station all gold or precious stones purchased by him since the last occasion of sending to such office, together with an exact copy of the portion of his register relating to the purchase of the gold or precious stones so sent, and where any portion of such gold or precious stones has been purchased from the holder or lessee of a claim or his agent, the authorisation from such holder or lessee for the sale of such gold or precious stones, and shall obtain a permit in Form No 17 in the First Schedule to these Regulations to convey such gold or precious stones to Georgetown, and shall pay royalty in accordance with these Regulations. **Form No. 17.**

147. The holder of every licence to trade in gold or precious stones shall be bound to notify to the Commissioner or Warden immediately on receiving such licence the place at which he intends to carry on his business, and the name of the person who will be in charge of such business, and shall thereupon affix to such premises in some conspicuous position a notice board with the following words painted on it in plain legible letters:— **Licensed trader to notify place of business and affix notice board.**

"Licensed to trade in Gold [and, or, Precious Stones]"

(*as the case may be*).

The book required to be kept by the holder of such licence shall be kept at such place of business, and shall be open at all times to the inspection of any Officer.

Penalty on licensed trader.

148.—(1) Every holder of a licence to trade in gold or precious stones who—

(*a*) Makes any incorrect entry in any book required to be kept by him under these Regulations ; or

(*b*) Refuses or neglects to produce such book for the inspection of any Officer ; or

(*c*) Refuses or neglects to comply with any of the duties or obligations imposed on him by or under these Regulations,

shall be liable to a penalty not exceeding one hundred dollars.

Power to cancel traders licence.

149. Where the holder of a licence to trade in gold or precious stones is guilty of a breach of any Regulation relating to licences of the kind held by him, the Governor-in-Council may, in addition to any other penalty provided for such breach, direct that his licence be forfeited.

Gold not to be sold at place not licensed.

150. No gold or precious stones may be purchased or sold except at the premises licensed for trading in gold or precious stones.

Penalty on person fraudulently working raw gold.

151. No person shall work up any gold into any article of jewellery or any other similar article until the royalty payable thereon is paid.

PART IX.

Sanitary Regulations.

Provision of latrine, etc., on claim.

152.—(1) Every holder of a claim or Permission under Regulation 79 shall provide for the use of all persons employed by him, within a reasonable distance, to leeward if practicable, of the camp or place where such persons are working, a properly screened latrine, with a pit or proper movable receptacle beneath, and also such other pits or trenches as may be necessary for the deposit of night soil.

(2) The position of such latrine and of such pits or trenches shall be subject to the approval of the Warden.

(3) Every such latrine shall be kept clean and disinfected to the satisfaction of the Warden.

(4) All night soil shall be deposited in such latrine or in such other pits or trenches, and not elsewhere.

Disposal of refuse matter.

153.—(1) Each Warden shall appoint suitable spots in the different parts of his Mining District for the deposit of rubbish and refuse matter, animal and vegetable, other than excreta.

(2) No person shall deposit, or cause to be deposited, any such rubbish or refuse matter in any place except the spot appointed by the Warden.

Removal of refuse matter.

154. The occupier of any dwelling-house, hut, logie, or tent in a Mining District nearest to which any rubbish or refuse matter or excreta is or are deposited shall be bound to bury at least three feet below the surface of the ground or remove or burn the same and shall so bury, remove or burn the same within twenty-four hours after being required by any Warden to do so.

Burial of dead animal.

155. The owner or any person in charge of any animal which dies on or near a claim shall, within twelve hours after such death, cause the animal to be burnt or buried at least six feet deep at a distance of not less than one hundred yards from any claim.

156.—(1) Every owner, person in charge or watchman at a magazine belonging to a claim shall be bound to keep the land around the magazine, within a radius of fifty feet, or such smaller area as may be under his control, in a clean state. Keeping clean of land around magazine.

(2) Every watchman who is guilty of neglect in this respect may be fined as for misconduct by the person in charge of the claim.

157. Every Warden may cause grave yards to be marked out and fenced off not less than a quarter of a mile from and if practicable to leeward of the camps in his Mining District; and the interment of persons dying in the district shall, as far as possible, be made therein, within thirty-six hours of death. Establishment of grave yards.

158. Every Warden may reserve such creeks for drinking purposes, as he may from time to time deem necessary, and thereupon, and until the reservation is removed, such creek shall not be open to location. Reservation of creek for drinking water.

159. Every person who wilfully or negligently causes the water of any well or dam on or near any claim, or of any creek used for drinking purposes and set apart by the Warden for that purpose, to become contaminated, shall be guilty of a breach of these Regulations. Causing water to become contaminated.

160.—(1) It shall be the duty of every holder or person in charge of a claim to see that the land to the extent of fifty yards (if under his control) surrounding the dwellings of the persons employed by him and living on or near the claim is as far as possible properly drained and kept clean, so as not to be injurious to the health or comfort of such persons. Drainage, etc., of land near dwellings.

(2) Every holder or person in charge of a claim who refuses or neglects to comply with any reasonable requirement of a Warden in this respect shall be guilty of a breach of these Regulations.

161. Any Warden may, at all reasonable times, enter in or upon any premises or claim for the purpose of ascertaining whether any nuisance exists on such premises or claim and whether the Regulations in this part, are being carried out, and of giving directions and taking steps to abate and remove any such nuisance and enforcing the said Regulations. Power of entry to abate nuisance, etc.

PART X.

Regulation of Mines.

162. The Commissioner may, in his discretion, declare any claim or part of a claim to be a mine, and may alter or revoke any declaration. Commissioner may declare mine.

163.—(1) Every holder of a mine, not being himself qualified as manager as hereinafter provided, on which are employed more than twelve men shall forthwith after the coming into force of these Regulations appoint and continue to have a manager, who shall be deemed the mining manager of the mines under this Part. Appointment of mining manager.

(2) The name and address of such manager for the time being shall be notified in writing by the holder of the mine to the Commissioner.

(3) No person shall be appointed manager of a mine who is not permitted by the Commissioner to act as such manager and who has not the management and control of the mining operations carried on at such mine.

Restrictions on employment of women and children.

164. No female of any age, and no male child under the age of fourteen years, shall be employed for hire in any capacity in connection with the working of a mine underground.

Regulation as to employment of boys.

165.—(1) No boy under the age of sixteen years shall be employed below ground for more than forty-eight hours in any week, exclusive of the time allowed for meals, or more than eight hours in any day.

(2) No male under the age of twenty years shall be employed as lander or braceman at any time at a brace over any shaft.

(3) No person shall be deemed guilty of a breach of this Regulation relating to the time for which persons shall not be employed below ground, if he proves there were special circumstances to render such contravention necessary for the proper working of the mine, and that such contravention was not injurious to the workmen employed in the mine.

Limitation of working hours of persons in charge of steam machinery.

166. No person in charge of steam or other machinery used in connection with any mine, or for the treatment of the products of any mine, shall be employed for more than eight consecutive hours at any time ; such period of eight hours shall be exclusive of any time occupied in raising steam, and in drawing fires and exhausting steam in connection with the machinery in charge of such person, and exclusive of meal hours, and of any time in which such person is employed in case of breakage or other emergency.

Power to authorise entry of surveyor, etc.

167. A Warden shall have power to authorise in writing the entry of any Surveyor, Assessor, Inspector, or other person into and upon any mine or site, for the purpose of measuring the depth of any shaft, dip, or inclination, or the length of any tunnel or drive, or for any other purpose.

General rules to be observed in working of mine.

168. The following general rules shall, so far as may be reasonably practicable, be observed at every mine, that is to say :—

(1) An adequate amount of ventilation shall be constantly produced in the mine to such an extent that the shafts, winzes, sumps, levels, and working places of the mine, and the travelling road to and from such working places, shall be in a fit state for working and passing therein ;

(2) When cross drives or openings are required for ventilation and the various parties concerned cannot agree thereon, the Warden or Mining Inspector may issue an order for making such drives or openings and for the allocation of the work to be performed, and also for the distribution of any auriferous deposits which may be found in the intervening wall ;

(3) Gunpowder or other explosive or inflammable substance shall only be used in the mine as hereinafter provided,

(*a*) It may be stored in a chamber or magazine of the mine, at a distance of not less than two hundred feet from where any blasting operations are being carried on;

(*b*) It shall not be taken for use into the workings of the mine except in a securely covered case or canister containing not more than eight pounds of gunpowder, or more than five pounds of nitro-glycerine compounds ;

(*c*) Detonators for blasting shall be kept on the surface of the ground in a covered box placed in the powder magazine and at least fifty feet from the nitro-glycerine compounds ;

(*d*) No person shall enter with a naked light a powder magazine or any excavation in the mine where powder or other explosive or inflammable substance is stored ;

(*e*) No iron or steel pricker shall be used in blasting in the mine, and no iron or steel tool shall be used in tamping or ramming, and no iron or steel pricker or tamping bar shall be taken into the mine except with the permission of a Warden or Mining Inspector ; and

(*f*) A charge which has missed fire may be drawn by a copper pricker, but shall not be visited until three hours have elapsed from the time of lighting the fuse of such charge ; nor shall any charge be drawn where nitro-glycerine compounds or detonators have been used ; but in no case shall an iron or steel drill be used for the purpose of drawing or drilling out such charge. This sub-section shall not apply to charges fired by an electric current.

(4) Every underground plane on which persons travel which is self-acting or worked by an engine, windlass, or gin shall be provided if exceeding thirty yards in length with some proper means of signalling between the stopping-places and the ends of the plane, and shall be provided in every case at intervals of not more than twenty yards with sufficient man-holes or places of refuge ;

(5) Every road on which persons travel underground where the produce of the mine in transit exceeds ten tons in any one hour over any part thereof, and where the load is drawn by a horse or other animal, shall be provided at intervals of not more than one hundred yards with sufficient spaces for man-holes or places of refuge, each of which spaces shall be of sufficient length and of at least three feet in width between the wagons running on the tram-road and the side of the road ;

(6) The top and all entrances between the top and bottom of every working or pumping-shaft shall be properly and securely fenced or securely covered ; but this provision shall not be taken to forbid the temporary removal of any fence or cover for the purpose of repairs or other operations if proper precautions are used ;

(7) Every abandoned or disused shaft shall be fenced or securely covered in by the owner thereof and its position indicated on the surface by a post or cairn of stones, or such other permanent distinguishing mark as the Commissioner or Warden or Mining Inspector may think sufficient ;

(8) Where one portion of a shaft is used for the ascent and descent of persons by ladders or man-engine, and another portion of the same shaft is used for raising material, the first-mentioned portion shall be cased or otherwise securely fenced off separate from the last-mentioned portion ;

(9) A clear view shall be kept for the engine driver between his station and the shaft at the surface-brace ;

(10) All methods of signalling to indicate that men or material are or is to be raised or lowered in shafts shall be clear and distinct, and shall be posted in a clear and legible form on framed boards ; one of which shall be placed at the chamber at the bottom of the workings of the shaft, and the other at the brace at or near the top of the shaft ;

(11) Whenever any underground work is being performed in a mine at a greater distance than two hundred feet from the shaft, proper means shall be provided for communicating along the lower drives of such mine distinct and definite signals to and from the plats at the bottom of the shaft, and to and from such places in which men may be at work ;

(12) Every brace shall be properly covered to protect the workmen from the inclemency of the weather ;

(13) A single linked chain shall not be used for lowering or raising persons in any working shaft or plane, except for the short coupling chain attached to the cage or load. When chains are employed as couplings, two single linked chains of uniform size shall be used to each coupling ;

(14) There shall be, on the drum of every machine used for lowering or raising persons, such flanges or horns, and also if the drum is conical, such other appliances as may be sufficient to prevent the rope from slipping ;

(15) There shall be attached to every machine worked by steam, water, or mechanical power, and used for lowering or raising persons, an adequate brake, and also a proper indicator (in addition to any mark on the rope), to show to the person who works the machine the position of the load in the shaft ;

(16) All boilers, compressors, engines, gearing, and other parts of machinery, when used for any mining purpose, or for the treatment of ores, or for the treatment of the products of any mine shall be kept in a fit state and condition ;

(17) Every steam-boiler shall be provided with a proper steam-gauge and water-gauge to show respectively the pressure of steam and the height of water in the boiler, and with a proper safety valve : and at least once in every six months or oftener, if required, every such boiler shall be thoroughly cleansed, and once in every twelve months every such boiler shall be subjected to a thorough examination and test by some competent person, and the date and full description of every such test and cleansing shall be entered in a book to be kept by the manager or other person in charge of the mine : and every such book shall, on demand, be open to the inspection of any Warden or Mining Inspector ;

(18) No person shall wilfully damage, or without proper authority, remove or render useless, any fencing, casing, lining, guide, means of signalling, signal, cover, chain, flange, horn, brake, indicator, ladder, platform. steam-gauge, water-gauge, safety-valve, or other appliance or thing provided in the mine in compliance with these Regulations ;

(19) In every working in the mine approaching a place likely to contain a dangerous accumulation of water, boring rods shall be kept and used for the purpose of perforating the ground twenty feet in advance of, or near, or at an angle from such working, and no drive, gallery, or other excavation shall be made within a dangerous distance of such accumulation of water :

(20) If the mine is, in the opinion of the Commissioner, or Warden or Mining Inspector, liable to an inundation or inburst of water, such additional rises, chambers, drives, and other workings, or any of them, shall be constructed as may seem necessary, and as may be prescribed by the Commissioner, or Warden or Mining Inspector, for the escape of workmen from the lower workings or to ensure their safety in the mine during the period of any inundation or inburst of water in the mine ;

(21) Ladders, and when necessary, convenient platforms connected therewith, shall be provided in each rise, jump up, or passage giving access to workings at a higher level in the mine ;

(22) In every case where vertical or overhanging ladders are used in connection with the shaft of any mine, securely fixed platforms shall be constructed at intervals of not more than thirty feet from each other in such shaft ;

(23) A printed copy of the foregoing general rules shall be posted in the office, and on a building or board in some conspicuous place in connection with the mine ; and

(24) Any manager or any person in charge of or giving orders or directions relating to the carrying on of any mining operations in the mine, who contravenes or does not comply with any of the aforesaid general rules, shall be guilty of a breach of these Regulations, unless he proves that he had taken all reasonable means to prevent such contravention or non-compliance.

Restriction to driving of tunnel.

169. It shall not be lawful for any person to drive a tunnel within ten feet or such other distance as the Warden or Mining Inspector may approve of a tunnel the property of any other person, except with the consent in writing of such other person, or the authority of the Warden or Mining Inspector and subject to such conditions as the Warden or Mining Inspector may consider necessary for safety and in all cases under this Regulation both the person driving the new tunnel and the owner of the other tunnel shall comply with such directions for ensuring safety as the Warden or Mining Inspector may give.

Provisions as to keeping plan of mine.

170.—(1) The owner, manager or person in charge of every mine where there are underground workings, shall keep at the office at the mine an accurate plan to scale of the workings of the mine made by a certified manager or a duly qualified mining engineer, or by a surveyor, showing the workings up to three months previously, and shall, on demand, produce such plan at the mine to any Warden or Mining Inspector and shall, if requested by any such Officer, mark on such plan the progress of the workings of the mine up to the time of such production, and shall allow such Officer to examine and take a copy or tracing thereof.

(2) Every such copy or tracing shall be deposited with such person at such place as the Commissioner may appoint, and no copy or tracing thereof shall be furnished or information in relation thereto given, nor such plans or tracings be open to inspection, except with the permission of the Commissioner.

(3) The Commissioner may, by notice in writing (whether a penalty for failing to comply with this Regulation has or has not been inflicted) require the owner, manager, or person in charge of any mine to cause an accurate plan, such as is herein prescribed, to be made within a reasonable time at the expense of the owner of the mine, on a scale of not less than two chains to one inch, or on such other scale as the plan then used in the mine is constructed on.

(4) All additions of any kind to the underground workings of such mine made after the date of such order shall be correctly delineated upon the original plan and sections, and also upon the copy deposited at the office at the mine, at intervals of not more than two months, and such original plan and sections shall contain complete information as to all the underground workings up to the date of the abandonment of such mine.

Inspection and safe working of mine, etc.

171. The Commissioner or Warden or Mining Inspector shall, from time to time, or when he may deem it necessary, inspect any mine or mining machinery, and may issue such orders for the safe working of such mine or machinery as he may deem advisable and may order work to cease on any part of the mine ; and the owner, manager, or person in charge of such mine or machinery shall carry out such orders.

Giving of notice as to danger or defect in mine.

172. If in any respect which is not provided against by any express provision of these Regulations, the Commissioner or Warden or Mining Inspector finds any mine or any part thereof, or any matter, thing, or practice in or connected therewith, to be dangerous or defective, so as, in his opinion, to threaten or tend to the bodily injury of any person, he shall give notice in writing to the owner, manager, or person in charge of the mine of the particular grounds on which he is of opinion that such mine or any part thereof, or any portion of the particulars aforesaid, is dangerous or defective, and shall in such notice require such owner, manager or person in charge to remove or remedy such danger or defect. Any owner, manager or person in charge who fails forthwith to remove or remedy such danger or defect shall be guilty of a breach of these Regulations.

Investigation of complaint made by miner.

173. Where any miner working in a mine makes a complaint under these Regulations to the Commissioner or Warden or Mining Inspector, it shall be the duty of the Commissioner or Warden or Mining Inspector as soon as possible to make inquiry into the matter of such complaint, and to take such other steps as he may deem necessary to investigate the matter, and the name of the informant shall not, except with his sanction, be divulged by the Commissioner or Warden or Mining Inspector.

Negligence of mining manager.

174. If a manager is shown to have been guilty of carelessness or negligence in the performance of his duties or in relation to any matter dealt with in these Regulations, his permission may be suspended for such time as the Commissioner may think fit, or may be cancelled by the Commissioner, subject to an appeal to the Governor.

175. Any accident occurring in a mine shall be *primâ facie* evidence that such accident occurred through some negligence on the part of the owner of the mine. Presumption of negligence from accident in mine.

176. The manager of every mine shall, forthwith after the occurrence of any accident attended with serious injury to any person, give notice in writing thereof to the Warden or Mining Inspector and shall also forthwith, if there is a telegraph or telephone station within ten miles of the mine, report the same by telegraph or telephone message to the Commissioner. Reporting of serious accident in mine.

177.—(1) Every person who is guilty of a breach of any Regulation contained in this Part shall be liable, where no penalty is expressly provided, if he is the owner, manager, or person in charge of or giving orders or directions relating to the carrying on of any mining operations in any mine, to a penalty not exceeding one hundred dollars, and, if he is any other person, to a penalty not exceeding fifty dollars. Liability for breach of Regulations of Part X.

(2) The whole or any part of such penalty may be awarded to any person injured in consequence of such breach, and such award shall not take away any right of action such person may have under these Regulations or otherwise.

PART XI.

Determination of Disputes.

178. All disputes by way of opposition to the issue of any licence, and all disputes as to what land is or is not lawfully occupied or has or has not been lawfully located, or any other disputes arising under these Regulations, shall be decided by the Commissioner, or by the Warden of the Mining District in which the dispute arises. General provision as to decision of disputes in first instances.

179.—(1) The person desiring to have any dispute other than by way of opposition settled shall file a complaint in writing setting forth the names of the parties to the dispute, a short statement of the cause of complaint, and the remedy or redress which he asks for, and shall, within seven days thereafter, serve on the opposite party, either personally or by leaving the same at his registered address in Georgetown, if he has one, or in such other manner as the Commissioner, or Warden, may direct, a copy of the complaint. Making of complaint.

(2) There shall be endorsed on the complaint an address in Georgetown or in the Mining District as the case may be, at which all notices may be served on the complainant.

180.—(1) The opposite party may, within seven days after service upon him of the statement or complaint, file an answer in writing stating how much he admits and how much he denies in the statement Filing of answer.

or complaint. He shall, within the same time, serve on the party complaining, at the address contained in the statement or complaint, a copy of the answer.

(2) There shall be endorsed on the answer an address in Georgetown or in the Mining District, as the case may be, at which all notices may be served on the opposite party.

Filing of reply.

181. On such answer being filed, the Commissioner, or Warden may, if he thinks fit, by notice in writing, require the complainant to file a reply; and in such case the reply shall be filed and a copy served on the opposite party within such time, and in such manner as may be prescribed in the notice.

Place for filing document.

182. Every person filing any document under the last three preceding Regulations shall do so in duplicate at the office either of the Commissioner or of the Warden.

Enlarging of time for filing document.

183. The Commissioner or Warden may on the *ex parte* application of either party or after such notice as he may direct, either before or after the time limited by this Part for the filing of any document or the doing of any act, enlarge the time for filing such document or doing such act.

Giving notice of hearing.

184.—(1) The answer or reply, as the case may be, having been filed or default having been made therein, the Commissioner, or Warden, shall forthwith cause notice in writing to be served on both parties at their addresses for services of the day, hour, and place at which the dispute will be heard and determined.

(2) If the hearing so appointed does not take place, a fresh notice of hearing may be served, and so on *toties quoties*.

Hearing.

185. At the day, hour, and place mentioned in the notice of hearing, the Commissioner, or Warden, shall proceed to hear and determine the dispute: Provided, however, that, in any case which is to be heard by a Warden, the Warden shall have power to refer the case to the Commissioner, and the Commissioner may hear and determine the same accordingly, or may in his discretion remit the case to be heard and determined by the Warden.

Proof of document.

186. Any extract from any book, record, or other document required to be kept by any Officer under these Regulations, or any copy of any document or of any entry in any book, or other record in the custody or possession, or under the control, of any Officer, under these Regulations, if certified to be true by the Officer for the time being in charge of such book, record, or other document, may be given in evidence on the hearing of any dispute or other proceeding without calling any such Officer to prove the same.

Place of sitting, etc.

187. The Commissioner or Warden shall for the purpose of hearing and determining any dispute, have power to sit in any part of the Colony and to adjourn from place to place as occasion may require.

Power to require survey, etc.

188. The Commissioner or Warden may, for the purpose of hearing and determining any dispute, require one of the parties to the dispute to cause such surveys and measurements to be made and taken as he may think proper; and he shall enter on the records of the proceedings the fact of his having required any such survey or measurement to be taken, and shall in his decision say on whom the expenses of the survey or measurement shall fall.

189.—(1) At the time appointed for the hearing of the dispute the opposer or complainant shall proceed to state his case and then examine his witnesses, who may be cross-examined and re-examined, and tender his documentary evidence, and if the opposite party adduces no evidence, the opposer or complainant may sum up his evidence, and comment thereon. Procedure at hearing.

(2) When the opposer or complainant has concluded his case, the opposite party may state his case and adduce evidence, and sum up and comment thereon.

(3) If the opposite party adduces no evidence, the opposer or complainant shall have no right of reply.

(4) If the opposite party adduces evidence, the opposer or complainant shall be at liberty to reply generally on the whole case.

190. After the hearing has been concluded the Commissioner or Warden shall give his decision and order and the reasons thereof in writing, which shall form part of the record, and shall intimate the same to the several parties as soon after the delivery of such decision and order as practicable. Giving of decision.

191. When the Commissioner or Warden declares that a location made by any party to a dispute, is null and void, the licence, if any, held by such party for the land included in such location as aforesaid, shall at the expiration of the period allowed for appeal against the decision of the Commissioner or Warden and provided that such decision is confirmed on appeal, *ipso facto* cease and determine. Determination of licences affected by decision.

192. The decision or order of the Commissioner or Warden shall be given effect to and be enforced notwithstanding any appeal, until such decision or order has been varied or set aside on appeal, unless the Supreme Court otherwise orders, for such reasons and on such terms as it may think fit. Enforcement of decision.

193. Every party shall be entitled, on application at the Office of the Commissioner or Warden, to a copy of the proceedings on payment of the prescribed fee. Right to copy of proceedings.

194. Any party aggrieved by any such decision as aforesaid may appeal therefrom to the Supreme Court. Appeal.

195. The Commissioner or Warden may, where it appears to him absolutely necessary to do so for the maintenance of the public peace or for the protection of the interests of the Crown or of private persons, order that all work shall cease on a claim, either generally or by any particular person or persons, and thereupon work shall be discontinued accordingly. Power to Commissioner or Warden to order work to cease.

196. If either party to an opposition or dispute refuses or neglects to give effect to any order or decision lawfully made therein, he shall in addition to any other penalty or process to enforce such order to which he may be subject forfeit all his interest in the subject-matter of the opposition or dispute, and be liable to a penalty not exceeding one hundred dollars. Consequence of refusal or neglect to give effect to order.

197. The fees specified in the second Schedule to these Regulations shall be payable in proceedings before the Commissioner or Warden for the determination of disputes, and the Commissioner or Fees. Schedule II.

Warden may award to either of the parties to any dispute such costs not exceeding in amount the costs payable in cases within the limited jurisdiction of the Supreme Court as in his discretion he thinks fit.

PART XII.

The Aboriginal Indians.

General saving as to Aboriginal Indians.

198. The Aboriginal Indians shall not be subject to these Regulations : Provided that where an Aboriginal Indian is the holder of a claim, his privileges as an Aboriginal Indian under these Regulations shall be suspended so long as he continues such holder.

Occupation of land by Aboriginal Indians.

199. All land occupied or used by the Aboriginal Indians, and all land necessary for the quiet enjoyment by the Aboriginal Indians of any Indian Settlement, shall be deemed to be lawfully occupied by them.

Protection of person lawfully occupying claim.

200. It shall not be lawful for any Aboriginal Indian to disturb any person lawfully occupying any claim or to take any gold or precious stones from any land lawfully occupied as a claim ; and all gold or precious stones found in the possession of an Aboriginal Indian, and which can be proved to have been removed from a claim, shall be forfeited.

Ill-use of Aboriginal Indian by claim-holder.

201. Any person occupying any claim who ill-uses any Aboriginal Indian in his employ shall forfeit all interest in any claim in which he may be interested.

Prohibition of obtaining gold or precious stones from Aboriginal Indian.

202. It shall not be lawful for any person to obtain, receive or purchase any gold or precious stones from an Aboriginal Indian, and all gold or precious stones so obtained, received, or purchased shall be forfeited.

Forfeiture of gold or precious stones obtained through Aboriginal Indian.

203. Where it appears to the Governor that any person has made use of any Aboriginal Indian to obtain any gold or precious stones in fraud of these Regulations or of the law, the gold or precious stones so obtained shall be forfeited, and may be applied for the benefit of such Indian or otherwise as the Governor may direct.

Disposal of gold or precious stones obtained by Aboriginal Indians.

204. Where any Aboriginal Indian obtains and desires to sell any gold or precious stones they shall be purchased by the Government, and the proceeds shall be paid to such Indian or applied as the Governor may direct.

Disposal of Forfeited Gold or Precious Stones.

Sale of forfeited gold or stones.

205. When any gold or precious stones are forfeited, they shall be sold by the Commissioner, and the proceeds applied as directed by Section 90 of "The Mining Ordinance, 1903," but the Governor may on the petition of any person interested in the gold or precious stones direct that the proceeds of such sale shall be paid to such person or persons as he may think fit.

Safety of Claims.

206. The Commissioner or Warden or Mining Inspector shall have power at any time he may think fit, to order work to cease on any part of any claim, where such working in his opinion endangers life or limb, and when such precautions as he directs have been taken, he may permit work to be recommenced. Commissioner may order work to cease on dangerous claims.

207. The Mining Regulations, 1903, contained in the First Schedule to the Mining Ordinance, 1903, are hereby revoked. Revocation of former Regulation, No. 1 of 1903.

Made by the Governor and Court of Policy under Section 81 *of the Mining Ordinance*, 1903, *this* 19*th day of October*, 1905.

By Command,

J. HAMPDEN KING,

Clerk of the Court

THE FIRST SCHEDULE.

FORMS.

Regulation 3.

Form No. 1.

Application for Prospecting Licence.

British Guiana.

The Mining Regulations, 1905.

To the Commissioner of Lands and Mines, Georgetown [*or* to the Warden, No. District].

I [*or* we] hereby make application for a Licence to prospect for Gold [or Precious Stones] within the Colony and to locate Claims therein.

Name, style, or firm (if any).
Address.
Registered Address.
Dated this day of , 19 .

(Signed)

Regulation 4.

Form No. 2.

Prospecting Licence.

British Guiana.

The Mining Regulations, 1905.

No. .

A Licence is hereby granted to of to prospect for Gold or Precious Stones within the Colony, and to locate claims therein.

This Licence shall remain in force for the purpose of prospecting until the day of

Dated this day of , 19 .

(Signed)

Commissioner of Lands and Mines [*or Warden*].

Regulation 6.

Form No. 3.

Authority from Licence Holder to Prospect.

British Guiana.

The Mining Regulations, 1905.

of

is hereby authorised to prospect for me within the colony and to locate claims therein on my behalf, under and subject to Prospecting Licence No.

This authority expires on the day of , 19 .

Dated this day of , 19 .

(Signed)

Approved.

(Signed)

Commissioner of Lands and Mines [*or Warden*].

Form No. 4. Regulation 7.

Notice of Location of Claim.

British Guiana.

The Mining Regulations, 1905.

To the Commissioner of Lands and Mines

On behalf of

I did on the day of , 19 , in the presence of and of locate a Claim in No. District under Licence No.

The situation and description of the claim located are as follows:—

DESCRIPTION.

Name of Creek, Hill or Flat

Name of River of which Creek is tributary

Length feet, width feet.

Distance to River or Creek landing

Name of some other Claim holder in immediate vicinity

Nearest Claim holder

Dated this day of , 19 .

(Signed)

Form No. 5. Regulation 7.

Application for Licence.

British Guiana.

The Mining Regulations, 1905.

To the Commissioner of Lands and Mines [or the Warden, No. District].

I [*or* we] (*insert names or names of holder or holders of prospecting licence*) hereby make application for a Licence to mine for Gold [and or Precious Stones] on a Claim located in District No. under Prospecting Licence No.

The situation and description of the Claim are contained in the Notice of Location attached hereto.

Dated this day of , 19

(Signed)

Holder of Licence [or authorised Agent of Holder of Licence].

Form No. 6. Regulation 8.

Receipt by Warden of Notice of Location and Application for Licence.

British Guiana.

The Mining Regulations, 1905.

This is to certify that I have this day received from on behalf of a Notice of Location by him of Claim in District No. under Prospecting Licence No. and an application for Licence therefor, and for filing which the sum of $ has been paid.

Dated this day of , 19 .

(Signed)

Warden.

No. District.

Regulation 14.

FORM No. 7.

Claim Licence—(a) *Gold;* (b) *Precious Stones;* (c) *Gold & Precious Stones.*

BRITISH GUIANA.

The Mining Regulations, 1905.

Licence is hereby granted to

of to occupy for the purpose of Mining for [(*a*) Gold; (*b*) Precious Stones; (*c*) Gold and Precious Stones, as may be required] under and subject to the Mining Regulations, 1905, a certain tract of Crown Land located in District No. on the day of 19 , under Prospecting Licence No. , the situation and description of which are as follows:—

Name of Creek, Hill or Flat

Name of River of which Creek is tributary

Length of Claim feet; width of Claim feet.

Distance of Claim to River or Creek Landing

Name of some other Claim holder in immediate vicinity

Nearest Claim holder

Dated this day of , 19 .

Value $.

Commissioner of Lands and Mines.

NOTE.—This Licence is issued in accordance with the description of the claim given by the locator thereof and without prejudice to the rights of any other persons in respect of the same land, and the locator takes the same subject to the condition that the location is as he alleges on Crown Land which can legally be located under the authority of the Mining Ordinance, 1903.

Regulation 44.

FORM No. 8.

Notice of Transfer of Licence or Concession.

BRITISH GUIANA.

The Mining Regulations, 1905.

I of

intend to transfer to of

* of my

right, title, and interest in and to the following Licence or Concession.

*Insert shares to be transferred.

(Signed)

Transferor.

Accepted by me to be held subject to said Regulations.

(Signed)

Transferee.

Registered Address.

Dated this day of 19 .

FORM No. 9. Regulation 46.

Certificate of Transfer of Concession or Licence by Sale at Execution.

BRITISH GUIANA.

The Mining Regulations, 1905.

I, the undersigned, Commissioner of Lands and Mines, do hereby certify that the transfer by sale at execution of rights under [a Concession or] Licence No. dated has been duly recorded by me in the Register of Concessions and Licences in my office and that the purchaser at execution sale is now the holder of such rights by transfer of such Concession or Licence.

Dated at Georgetown this day of .

Commissioner of Lands and Mines.

FORM No. 10. Regulation 50.

Mining Privilege.

BRITISH GUIANA.

The Mining Regulations, 1905.

No.

Permission is hereby granted to
of
to work as a Tributer in Mining District No.
for a period of twelve months from date.

Dated this day of , 19 .
Issued at
(Signed)

Commissioner or Warden.

FORM No. 11. Regulation 97.

Receipt for Gold or Precious Stones paid by Tributer to Claim Holder.

BRITISH GUIANA.

The Mining Regulations, 1905.

No.

District No.

Received from
the Holder of Mining Privilege No. dated
the undermentioned Gold (or Precious Stones)

	Ozs.	Dwts.	Grs.
Quantity of Gold			
Precious Stones Number		Carats	
Number of Claim Holder's Licence			
Situation of Claim		Creek	River

Dated this day of , 19 .
Signed

Claim Holder.

X

Regulation 109.

Form No. 12.

Certificate to work in a Mining District.

British Guiana.

The Mining Regulations, 1905.

No.

This is to certify that of of whom a description is given below, has this day been registered in* to work in the District for A. B. for a period of from this date.

*Georgetown or District No.

Dated this day of , 19 . (Signed)

Regulation 114.

Form No. 13.

Certificate of completion of Contract.

The Mining Regulations, 1905.

This is to certify that A. B. who holds a Certificate of Registration No. of the day of has completed his service under the Contract therein referred to.

(Signed)

Employer.

Dated this day of , 19 .

Regulations 26, 131 and 137.

Form No. 14.

Permit to convey Gold [or Precious Stones] from a Claim to Georgetown.

British Guiana.

The Mining Regulations, 1905.

Permit No. District No.

Permission is hereby granted to convey the undermentioned Gold or Precious Stones to Georgetown.

	Ozs.	Dwts.	Grs.
Quantity of Gold			
Precious Stones No. Carats			
Description of Receptacle			
Name of Person in charge			
Name of holder of Licence or Concession			
Number of Licence or Concession ...			

(Signed)

Warden.

Dated this day of , 19 .

Regulations 40, 141 and 146.

Form No. 15.

Authority from Claim Holder or his agent to sell Gold or Precious Stones.

British Guiana.

The Mining Regulations, 1905.

District No.

is hereby authorised by me to sell the undermentioned Gold [or Precious Stones] obtained from a Claim held under Licence or Concession No.

	Ozs.	Dwts.	Grs.
Quantity of Gold			
Precious Stones No. Carats			
Name of holder of Licence or Concession			

Date

(Signed)

for and on behalf of

Claim Holder.

Form No. 16.

Regulation 146.

Receipt for Gold or Precious Stones sold to a Trader in a Mining District.

British Guiana.

The Mining Regulations, 1905.

No.

No.

Received from

the undermentioned Gold (or Precious stones) sold to me under the said Regulations:—

		Ozs.	Dwts.	Grs.
Quantity of Gold				
Precious Stones	Number			Carats.
No. of Mining Privilege				
Date of Mining Privilege				
Name of Claim Holder on whose Claim the Gold or Precious Stones was obtained				
No. of Licence				

Signed

Holder of Licence to trade in Gold or Precious Stones.

Dated this day of , 19 .

Form No. 17.

Regulation 146.

Permit to convey Gold [or Precious Stones] sold to Georgetown.

British Guiana.

The Mining Regulations, 1905.

Permit No. District No.

Permission is hereby granted to the Trader (1) whom the undermentioned Gold [or Precious Stones] has been sold to convey the said Gold [or Precious Stones] to Georgetown.

(1) or agent of the trader, *as the case may be.*

		Ozs.	Dwts.	Grs.
Quantity of Gold				
Precious Stones No.	Carats. ...			
Description of Receptacle				
Name of Person in charge				
Name of Holder of Licence [or Concession]				
Number of Licence [or Concession] ...				

(Signed)

Warden.

No. District.

Dated this day of , 19 .

Regulations 4, 5, 7, 19, 31, 38, 48, 51, 87 and 197.

THE SECOND SCHEDULE.

TABLE OF FEES.

For a Prospecting Licence	$ 5 00
On filing Notice of the Location of any Claim and application for a Licence	0 48
For filing Application for a Concession	10 00
For a Certified Copy of particulars relating to a Prospecting Licence	0 12
For a Licence to mine for Gold for each financial year or part thereof	5 00
For a Licence to search for Precious Stones, for each acre or part of an acre, for each financial year or part thereof ...	0 20
For a Licence to mine for Gold and Precious Stones	5 00
and in addition for each acre or part of an acre, for each financial year, or part of a financial year	0 20
For every duplicate Licence issued	0 50
For every duplicate Concession issued	1 00
For filing Notice of a Transfer of any single Claim or of any number of Claims	1 00
For every metal tablet to be affixed to a claim	0 24
For every Mining Privilege under Regulation 51 (3)	0 24
For each Certificate, including Registration of Labour	0 24
Surveys—	
For surveying a Claim, exclusive of cost of survey, per acre ...	0 10
(This charge to include one copy of the diagram.)	
Fees in proceedings before the Commissioner or Warden—	
Filing Complaint	0 48
Summons of a Witness	0 24
Copy of Evidence or any document, per page of eighteen lines ...	0 12
Witnesses' Remuneration (not to exceed the sums specified) per diem, viz:—	
Agricultural Labourer, Seaman, Domestic Servant, or day Labourer or the wife or child above 12 years of age of any such person	0 72
Every other person, except a child under 12 years of age ...	2 00
Child under 12 years of age	0 24
and such actual travelling expenses as may be allowed by the Officer hearing the case.	

Section 92.

THE SECOND SCHEDULE.

Enactments Repealed.

NUMBER AND YEAR.	SHORT TITLE.	EXTENT OF REPEAL.
No. 3 of 1887 ...	The Mining Ordinance, 1887 ...	The whole.
No. 3 of 1895 ...	The Statute Laws Revision Ordinance, 1895	Sub-section (5) of section 2.
No. 12 of 1895 ...	The Statute Laws Revision Ordinance (No. 5), 1895 ...	Section 5.
No. 15 of 1896 ...	The Mining Ordinance, 1896 ...	The whole.
No. 20 of 1900 ...	The Partnership Ordinance, 1900	Sub-section (2) of section 48, and section 49.
No. 3 of 1901 ...	The Mining Ordinance, 1887, Amendment Ordinance, 1901...	The whole.
No. 28 of 1902 ...	The Statute Law Revision Ordinance, 1902	Section 8.

THE MINING ORDINANCE, 1903.

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APPENDIX B.

TERMS and conditions fixed by the Governor-in-Council under which permission shall ordinarily be given to temporarily occupy and test the value of unoccupied Crown Lands under the provisions of Section 14 (2) of the Mining Ordinance, 1903 :—

1. (*a*) The right shall not be granted for a longer period than three years.

(*b*) The area shall in no case be less than 500 acres: to be defined by natural features or as prescribed by Regulations 29 and 30 of the Mining Regulations, 1903.

(*c*) There shall be payable in advance for every such right a fee of seven and a half cents for every acre for every financial year or part of a year for which it is in force, and the right shall remain in force only so long as the fee is not in arrears.

(*d*) All Mining claims previously located within the boundaries of such area shall be excluded from the right and from the surface for which fee is payable.

(*e*) The grantee of the exclusive right shall be free from time to time to abandon any part or parts of the area granted to him, and, when he has properly demarcated the area so abandoned and shown it to the satisfaction of the Warden no exploration fee for subsequent financial years shall be payable by him thereon.

(*f*) During the continuance of this exclusive right of occupation and exploration the grantee shall be at liberty to mark off such rectangular areas as he may desire to have the exclusive right of working, and a grant of the exclusive right of working the same may be given him on his application by the Governor under Section 15 of the Mining Ordinance, 1903 ; provided that no such area shall be less than 1,500 feet by 800 feet.

2. So much of every area granted for occupation and exploration, as shall be abandoned by the grantee or not allocated to him as a grant for exclusive working before or at the expiration of his exclusive privilege of exploration, will become open for application and location to all persons.

3. Every application for permission to explore shall be advertised in the Official Gazette at the cost of the applicant for three consecutive Saturdays in order to allow of any opposition to the granting of the same being made.

4. In the rectangular areas described in conditions 1 (*f*), the area shall be demarcated as prescribed by Regulations 29 and 30 of the Mining Regulations, 1903.

APPENDIX C.

TERMS and conditions fixed by the Governor-in-Council under which Concessions shall ordinarily be granted under Section 15 (i) and (ii) of the Mining Ordinance, 1903, to occupy any portion of the Crown Lands of the Colony and therein to mine for and when found to take and appropriate (i) Gold, Silver and Valuable Minerals ; or (ii) Precious Stones :—

1. The Holder of the Concession shall pay in advance to the Receiver General on the 1st April in each year a rental of 20 cents per acre or part of an acre per annum.

2. The Holder of the Concession shall except when prevented by inevitable accident or during the execution of repairs or except he has obtained the permission in writing of the Commissioner of Lands and Mines or the Warden of the District to cease work thereon, diligently explore and search for (i) gold, silver and valuable minerals : or (ii) precious stones on the land specified in the Concession, in a skilful and workmanlike manner to the satisfaction of the Commissioner of Lands and Mines and shall not use the said land for any other purpose than the purpose for which the Concession is granted without the express sanction in writing of the Commissioner of Lands and Mines first obtained.

3. The Holder of the Concession shall as often as required in writing so to do by the Commissioner of Lands and Mines or other officer in that behalf appointed by him, furnish such true and proper returns and statistics or other particulars of the operations to be carried on upon the said land and the results thereof as the Commissioner of Lands and Mines or other Officer in that behalf appointed by him may require, verifying the same if and when required so to do by a statutory declaration of the truth and correctness thereof.

4. The Holder of the Concession shall be bound to keep the boundary lines of the Concession clearly marked by lines distinctly defined from corner to corner by a path not less than four feet wide and by a tree or corner post or beacon at each corner of the Concession standing not less than five feet out of the ground on which shall be securely fastened a board or other object on which shall be plainly and permanently marked otherwise than by the affixing of paper or other material which may be liable to be washed off, the name of the Holder of the Concession and the number, date and area of the Concession.

5. The Concession shall be subject to the right of aboriginal Indians—without disturbing the holder—to camp, hunt and traverse the land without molestation.

6. The Holder of the Concession shall not plead acceptance of the rent or royalty payable thereunder as a waiver of the right of the

Commissioner of Lands and Mines or other officer on his behalf to enforce the observance of the conditions of the Concession or of the right of the Governor-in-Council to cancel the Concession for any breach thereof respectively.

7. The Governor may grant to any person or persons a Concession to construct a Railway across or through any portion of the land comprised in the Concession without the holder thereof, having any right to compensation in respect of such parts of the said land as may be required for the purposes of the Railway, or to any abatement of the rental payable under his Concession in respect of such parts of the said land.

8. If at any time during the term for which the Concession is granted any part or parts of the land comprised therein shall be required for the purpose of any Township, Village Road, Canal, Railway, Railway Stations and approaches thereto, or Tramways, or for any other public purpose whatever, it shall be lawful for the Commissioner of Lands and Mines on giving three months' previous notice in writing to cause to be set out the part or parts of the said land which are so required and as soon as the same shall be so set out, such part or parts of the said land shall cease to be included in the Concession and the holder thereof shall not be entitled to any abatement of rent or any compensation whatsoever in respect thereof.

9. The Holder shall make such provision for the disposal of detritus earth, waste refuse or workings, resulting from any mining or other authorised operations to be carried on by him so that the same shall not be or become a nuisance, inconvenience or obstruction to any road, tramway, railway, telegraph line, race dam or creek or private or Crown Lands or in any manner occasion private or public damage or inconvenience.

10. The Holder shall from time to time upon being required in writing so to do by the Commissioner of Lands and Mines or other officer in that behalf appointed by him, well and sufficiently bale and pump, draw away and remove all water from the workings in the land comprised in the Concession, which, in the opinion of the Commissioner of Lands and Mines or other officer as aforesaid, is or may be injurious to the owner or occupier of any adjoining land, and continue to keep the said workings free of water so long as it may be so required as aforesaid.

11. The Holder shall not close up or obstruct any adit or adit tunnels or airways to or from any contiguous Mine or Mines whereby fresh air is admitted or ventilation promoted.

12. The Holder shall at all times during the continuance of the term of the Concession diligently observe and comply with Part X. of the Mining Regulations, 1905, relating to the Regulation of Mines and with all such other provisions of the said Mining Regulations as may *mutatis mutandis* be applicable.

13. All Transfers and assignments of the Concession shall be made in accordance with the requirements of Part V. of the Mining Regulations, 1905.

14. The Governor-in-Council, may under the provisions of Section 25 of the Mining Ordinance, 1903, for a breach of any of the conditions herein specified, cancel the Concession and all the rights, title and interest of the Holder of the Concession, and of all persons claiming under or through him shall therefrom cease and determine and the production of a copy of the aforesaid *Gazette* containing a notice purporting to be signed by the Commissioner of Lands and Mines notifying the cancellation of the said Concession shall be deemed to be conclusive evidence in all Courts in the Colony that the Concession has been duly cancelled and thereupon it shall be lawful for the Commissioner of Lands and Mines, his agents or officers or other person duly authorised thereto to enter forthwith into and upon the said land and premises and the same to repossess and enjoy in behalf of His Majesty as fully and effectually to all intents and purposes as if the land included in the Concession had not been granted.

15. The Holder shall at the end of the term for which the Concession is granted or sooner if the Concession is cancelled or otherwise determined before the expiration of the said term deliver peaceable possession of the land to the Commissioner of Lands and Mines or other officer authorised by him to receive possession thereof and shall thereafter remove all tools, appliances and Mining Plant from off such land within such time as the Commissioner of Lands and Mines may specify.

16. Before any Concession is granted the land applied for shall be surveyed at the cost of the applicant by a Surveyor of the Department of Lands and Mines, or with the approval of the Commissioner of Lands and Mines, by some other duly qualified Surveyor.

INDEX AND SYNONYMS

OF

NAMES OF PLACES, BRITISH GUIANA.

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