C O N T E N T S

		PAGE
I.	INTRODUCTION	1
	Acknowledgements	1
II.	REVIEW OF THE YEAR	2
	Staff	3
	Scholarships	5
	Centralization	
	Staff Conferences.. ..	
	United Kingdom Atomic Energy Authority	6
	Visitors	6
	Mineral Production ..	7
III.	GEOLOGICAL SURVEY	
	Summary of Field Work ..	
	Geophysical Surveys	10
	Pollen Analysis ..	10
	Tours of Inspection	11
IV.	MINERAL DEVELOPMENT	
	Summary	13
	Bauxite	13
	Chromium	14
	Clay Materials	15
	Columbite..	15
	Diamonds	15
	Gold	15
	Lime	16
	Manganese..	16
	Oil	17
	Radioactive Minerals	17
V.	WATER SUPPLY	
	The Coastal Artesian Basin ..	18
	Field Work	20
Vi.	HEADQUARTERS	
	Administrative Office ..	22
	Library and Records ...	22
	Drawing Office ..	24
	Laboratory	25
VII.	PUBLICATIONS AND REPORTS	

APPENDIX I

Preliminary Geological Reports

APPENDIX II

List of Senior Staff of the Geological Survey of British Guiana at 31st December, 1958.

ILLUSTRATION

Map of British Guiana showing mapping progress

REPORT ON THE GEOLOGICAL SURVEY DEPARTMENT OF BRITISH GUIANA FOR THE YEAR 1958

I. INTRODUCTION

The Geological Survey of British Guiana is an independent department responsible to the Ministry of Natural Resources. It is financed partly under free grants from the United Kingdom through the channel of the Colonial Development and Welfare Fund and partly by a charge on local revenues. A new four-year Colonial Development and Welfare Scheme No. D 2792 came into effect in 1956 making provision for the expansion of the Geological Survey Department to carry out intensive mineral development during the period 1st April, 1956, to 31st March, 1960. Of this expenditure £359,385 is to be borne by C.D. & W. funds and the remaining £77,000 by local funds.

During the year ending 31st December, 1958, the total expenditure of the Geological Survey Department was £74,883, of which £61,593 was a charge to the C.D. & W. Fund.

ACKNOWLEDGEMENTS

The Geological Survey is, as usual, much indebted to the mining companies and small miners for their co-operation during the year. The hospitality of the Demerara Bauxite Company Limited was enjoyed by members of the department on several occasions and much help was given to geologists working in the vicinity of Mackenzie and Ituni.

The Reynolds Metals Company helped to organize several visits to their properties at Kwakwani and on the Corentyne River by members of the department, and their hospitality is gratefully acknowledged.

Geologists of the department visited the Konawaruk, Mahdia and Tumatumari areas several times during the year and enjoyed the close co-operation and hospitality of the Manager and officials of British Guiana Consolidated Goldfields.

The United States Overseas Mission in British Guiana, representing the International Co-operation Administration, kindly arranged with the United States Geological Survey for two of our officers to take study courses in the United States.

The Director of the Instituto Geologico Nacional of the Republic of Colombia very kindly allowed Dr. T. van der Hammen, his chief Palaeobotanist, to spend three weeks in British Guiana making a collection of pollens from the beds of the Corentyne Series.

The Geological Survey is also indebted to the Department of Lands and Mines for much information on mineral concessions in the Interior, and for assistance in the mapping programme; to the Public Works Department for preparing plans for our new buildings and supervising construction; to the Telecommunications Department for the supply and maintenance of radio sets; to the Drilling Superintendent, Pure Water Supply for co-operation in the investigation of the capacity of the Coastal Artesian Basin; to the Forest Department for assistance with river transport and for making an extensive collection of pollen from their herbarium to assist Dr. van der Hammen in his studies; and to the Interior Department for support during a survey of the upper Mazaruni River area.

II. REVIEW OF THE YEAR

The outstanding event of the year was the granting of exploration rights on the continental shelf of British Guiana to the Standard Oil Company of California. A new subsidiary of the company was formed called the California Oil Company (British Guiana) Limited, and a marine seismic survey of the whole lease area was completed in September. Final results of this survey were not available at the year's end.

The United Kingdom Atomic Energy Authority established an office in the Geological Survey Compound in Georgetown, and a geologist with special training in the geology of uranium arrived in June to organize exploration work for radioactive minerals and other strategic minerals such as beryl.

A study of the pollens of the White Sand or Berbice Formation was undertaken with the co-operation of a palaeobotanist from the Republic of Colombia with the object of establishing horizons for correlation. It is hoped that the work will be of benefit to the bauxite companies as well as of assistance in the study of the hydrology of the coastal artesian basin.

The North West Mining Company Limited continued to make good progress in preparing for production from the Matthews Ridge manganese deposits near Arakaka.

The senior staff of the Geological Survey Department was brought up to full strength for the first time since the original Colonial Development and Welfare Scheme for an expansion of the Geological Survey was introduced in 1947. In consequence of this increase in staff geological mapping made much progress. The chief centre of activity was the belt of gold-bearing formations in the Kuribrong-Kaburi-Mahdia-Konawaruk-Siparuni areas. A programme of mapping in the North West District was started and some mapping completed in the Supenaam-Blue Mountains-Lower Cuyuni areas. Work was also carried out in the Mazaruni, Potaro, and Rupununi Districts.

A detailed study of the geological setting of the bauxites and aluminous laterites of British Guiana was started, and a geologist made a tour of the small

diamond and gold workings in the Mazaruni-Potaro, and Kaburi areas.

The geophysicist-hydrologist continued the study of the coastal artesian basin after returning from a training course in the United States.

STAFF

The senior staff was up to establishment at the end of the year for the first time since the post-war expansion programme. The number of Guianese scientists on the staff was raised to five out of an establishment of nineteen.

Mr C.G. Dixon, Deputy Director, took four months' vacation leave in the United Kingdom from 24th April.

While on vacation leave Mr D. Bleackley, Senior Geologist, was accepted as a candidate for the degree of D.Phil. at Oxford University and kept his first term of residence. He assumed duty again in the Colony on 19th May and acted as Deputy Director during the absence on vacation leave of Mr Dixon.

Dr J. Schilling arrived in June to take up the new appointment of Chemist-Petrologist. Dr Schilling is a Dr Phil. of the University of Berne, Switzerland, and has shown great energy and enthusiasm in his work of reorganizing the Geological Survey Laboratory and advising on the classification of the granitic and metamorphic rocks of the Colony.

Dr L.E. Ramsahoye, appointed last year as Temporary Geologist, transferred to the new appointment of Geophysicist-Hydrologist. He was absent in the United States on a study course for three months from 15th July and resumed the study of the coastal artesian basin on his return.

Mr R.T. Cannon went on vacation leave on 4th January and was granted an extension of six months study leave. He spent the whole year at University College, London, and qualified to submit a thesis for the degree of Ph.D.

Mr P.B.H. Bailey, Senior Geologist and Mr C.H. Barron, Geologist, left for four months vacation leave, the former from 13th December, and the latter from 24th August.

Mr P.I. Morris, Geologist, was also absent on five months vacation leave from 16th June.

Mr J.W. Lloyd and Mr K. Bramley were appointed Geologists w.e.f. 18th January and 10th March respectively, and Mr J.W. Carter Assistant Geologist w.e.f. 15th November. Mr Carter was a Government Conditional Scholar and is the third Guianese to complete the course in mining geology at the Imperial College of Science.

Mr R.A. Dujardin did not renew his contract on its expiry, and he is now employed by a Canadian mining company.

Mr T. M. Rahaman was appointed to the new post of Drawing Office Supervisor on 10th August. Mr Rahaman is from Trinidad and has had considerable experience in the drawing offices of two oil companies and with the Government Petroleum Engineer.

Mr L.F. Choy, Class I Clerk in charge of accounts, was absent on six months vacation leave in the West Indies from 23rd April. He was replaced by Mr V.H. Campbell, Class I Clerk.

Miss Irma Lowe, Senior Drawing Office Assistant, returned in April from six months vacation leave in the United Kingdom, during which she took a three months study course under the West Indies Training Scheme. This course was arranged by the Directorate of Overseas Surveys at Tolworth, Surrey.

Mr H.K. George was appointed on 15th April to the new post of Supervisor of Library and Records, he had previously worked in the Public Free Library, New Amsterdam.

Mr K. Lall, Drawing Office Assistant, was promoted to become Senior Drawing Office Assistant, and Messrs R. Rego and R. Briggs, Field and Office Assistants, became Senior Field and Office Assistants. Mr H.A.G. Best, Technical Assistant, resigned.

Mr O. St. John, Field Observer, left on 10th July, for the United States on vacation leave, he has been granted an additional four months study leave. An eight-months course on photogeology has kindly been arranged by the United States Geological Survey under the auspices of the International Co-operation Administration. Mr St. John will also attend lectures at George Washington University. This officer has a long and admirable record of field expeditions as he has worked for the Geological Survey since leaving school in 1943. He was promoted Field Observer in 1957. It is a great pleasure to thank the United States Geological Survey for enabling him to take this training course.

Miss R.E. Harry was appointed Secretary on promotion from the post of Clerical Assistant in the Ministry of Labour, Health and Housing and assumed duty on 23rd June.

Other appointments were as follows:-

Mr D. Hope, Technical Assistant	1/10/57
Mr J.E. Holder, Field and Office Assistant -	1/1/58
Mr S. O'Selmo, do do do do	do
Mr V.A. Agrippa, do do do do	do
Mr E. Clementson, Boat Captain do	do
Mr R. V. Yan, Drawing Office Assistant -	1/11/58
Mr A.S. Persram, Field & Office Assistant	1/11/58

Approval was obtained for four additional posts on the junior staff to be made pensionable. This was considered necessary in order to attract the most suitable staff to build up a permanent junior technical staff for the Geological Survey Department.

SCHOLARSHIPS

Mr M.A. Lee and Mr S. Singh continued their courses at the Imperial College of Science, London, and Swansea University respectively; they are expected to qualify in 1959.

Mr G.A. Sampson, Field and Office Assistant, was admitted to Devonport Technical College on 15th September to study for the G.C.E. Advanced Level in Pure and Applied Mathematics to qualify for entry to the mining geology course at the Imperial College of Science.

Mr A.S. Persram, Field and Office Assistant was offered a Government Conditional Scholarship to study in the United Kingdom for the degree of B.Sc. with honours in geology.

CENTRALIZATION

The policy of centralizing the Geological Survey in Georgetown, begun in 1957, was further developed during the year. All the geologists were based on Georgetown except the District Geologist, Bartica, who will continue to be based there, and one geologist who remained in New Amsterdam temporarily owing to the shortage of accommodation in Georgetown.

A new wing was added to the headquarters building in Brickdam in Georgetown to provide extra office room for the geologists. Five double offices and one single office for geologists, one office with a small laboratory for the geophysicist-hydrologist, and a large drawing office have been provided. Construction began in July and the building was ready for occupation at the year's end.

Plans for an apartment building on an excellent site in the centre of Georgetown to provide accommodation for overseas geologists were approved and put out to tender. Four two-bedroom and two one-bedroom flats are to be provided and it is hoped that they will be ready for occupation by mid-1959.

Further improvements to the Geological Survey compound in Brickdam are being planned.

STAFF CONFERENCES

Conferences uniting senior scientific staff were held during May and July. These conferences last from three to four days and are held twice a year after each field season. The geologists give short talks on the work accomplished during their field expeditions and answer questions from the other geologists. In this way the progress in geological mapping becomes familiar

to all, and through discussion of the problems in each area it becomes possible to establish interpretations which are generally agreed. The second conference was attended by Mr I.T. Ralston, Geologist of the United Kingdom Atomic Energy Authority.

UNITED KINGDOM ATOMIC ENERGY AUTHORITY

The Authority has decided to establish an office in Georgetown to stimulate the search for radio-active minerals and other minerals such as beryl which are required in connection with atomic reactors. Mr I.T. Ralston, geologist, arrived in Georgetown in June as officer in charge and made arrangements for an office building with a small laboratory and store to be constructed in the Geological Survey compound. This office was ready for occupation in November.

Mr Ralston is working in close co-operation with the Geological Survey and was enabled to see many parts of British Guiana by visiting our field expeditions. He has taken charge of the maintenance of the Survey's electronic prospecting equipment and his help and advice are much appreciated.

AIR PHOTOGRAPHY → (insert new section)

VISITORS

Brigadier M. Hotine, C.M.G., C.B.E., Director of Overseas Surveys and Adviser to the Secretary of State, visited British Guiana in February and held consultations regarding the air survey of the Colony. M. M. Seyer, Chief Mining Engineer, French Overseas Divisions, and M. Y. Martel, Head of the Mining Service in French Guiana and the French West Indies, also visited the Colony in February.

Other visitors included:-

Prof. G.W. Bain of Amherst College, Amherst, Mass.

Prof. Theo. L. Hills of the Department of Geography, McGill University, Montreal, Canada.

Prof. Merrill, Department of Geography, Carleton University, Ottawa, Canada.

Ir H. Coutinho, Surinam Aluminium Co. Ltd.

Ir Tissot van Patot, M.V. Billiton Maatschappij, Surinam.

Mr W.R. Haynes, a prominent Texas oil executive.

Dr J.H. Westerman, Netherlands Foundation for the Advancement of Research in Surinam and Netherlands Antilles.

Dr J.E. Heesterman, Deputy Secretary General, Caribbean Commission.

Mr S. Headley.

In addition to many local miners and prospectors, geologists and engineers of the following companies visited the Department for discussions and advice:-

Demerara Bauxite Company, Limited

Sprostons Construction Company

Reynolds Metals Company

Reynolds Metals Company, Surinam

African Manganese Company, Limited

Boyles Bros, Limited.

Martin, Sykes and Associates

Colonial Development Corporation

B.G. Consolidated Goldfields, Limited

California Exploration Company, Limited

California Oil Company (British Guiana) Limited

Western Geophysical Company of America

Pan Venezuela Oil Company, Limited

Columbium Corporation

Surinam Gold Mines, Limited

Roraima Mining, Limited

Fairey Air Surveys, Limited

B.G. Diamond Mining Corporation

MINERAL PRODUCTION

The following table gives a comparison of the mineral production of British Guiana in 1957 and 1958; the figures supplied by the Commissioner of Lands & Mines:

MINERALS	1957 Amount	1957 Value $	1958 Amount	1958 Value $
Bauxite (Long Tons)	2,201,903		1,585,879	
Diamonds (Metric Carats)	29,037	1,342,381	33,091	1,046,500
Gold (Oz.Troy)	16,491	990,120	17,500	1,435,818
Granite (Long Tons)	-		68,929	641,446

N.B. Provisional Valuation

$1 B.W.I. = $0.58 U.S.

= 4s. 2d. Sterling

The Comptroller of Customs and Excise has kindly provided the following figures for the quantity and f.o.b. value of mineral exports for 1958:

MINERALS	EXPORT	VALUE
Bauxite (Long Tons)		
Metal and Chemical Grades	1,168,637	13,392,778
Calcined	195,649	7,169,410
Diamond (Metric Carats)	31,093	1,393,755
Gold (Oz. Troy)	10,777	644,466
		$22,600,409

The mining companies cut back their production of bauxite during 1958 owing to the world-wide trade recession. An increase in the production of diamonds was recorded due to a new discovery in the Upper Kurupung River late in the year.

III. GEOLOGICAL SURVEY

SUMMARY OF FIELD WORK

The field work of the Geological Survey is normally carried out during the two dry seasons, February to May and August to November. In 1958, owing to the incidence of leave, one Senior Geologist, three Geologists and two Assistant Geologists were available for geological mapping during each of the field seasons. One Assistant Geologist was attached to the Geophysicist-Hydrologist and another was engaged in a study of alluvial mining areas. 4,270 square miles were mapped at a scale of 1:125,000; a certain amount of revision is included in this figure. The mapping programme was aimed at checking and revising the geological relationships expressed in the provisional stratigraphical table published in the Annual Report for 1957, and in filling in gaps with a view to completing a reconnaissance map of the whole Colony. Particular attention was paid to certain gold, diamond and columbite producing areas and a mapping campaign was started in the North West District.

A reconnaissance survey of the Pakaraima Mountains was started in the upper basin of the Mazaruni River. The Roraima Formation here consists of red, pink, and light grey current-bedded sandstones, locally arkosic, with some conglomerates and quartzites and occasional beds of shales, cherts and jaspers. The major intrusions of gabbro were mapped as conformable sills or laccoliths attaining 1,000 feet in thickness. The formations have a gentle regional dip of 1° to the southwest and an analysis of the foreset bedding indicates that a part at least of the sediments was derived from the northeast. Microfossils were found in the cherts at one locality but are still unidentified. Diamonds were being mined in the Amerindian Reservation in the bed of the Mazaruni River and in right-bank tributaries, but diamond indications in the rivers descending from the high range joining Mounts Roraima and Ayanganna did not appear promising.

In the Rupununi District the correlation of micaceous sandstones, shales and mudstones previously reported near Apoteri in the Rewa, Rupununi and Essequibo Rivers with the Takutu Formation was confirmed, although no fossils were found. It is now believed that these beds, which are provisionally placed in the Permo-Trias on the evidence of fossil remains, underlie the North Savannas and a large portion of the remaining low-lying forest-covered ground between the Pakaraima and Kanuku Mountains. Makarapan Mountain, between Apoteri and Annai, was found to consist of a pluton of unfoliated riebeckite granite five miles in diameter. The survey of the Muruwa, Siparuni and Burro-burro River basins, along the projected Potaro-Lethem road, was continued and it was confirmed that the Rupununi Rhyolite Formation passes to the north into the acid volcanics of the Mazaruni Group. Quartzitic sandstone members of this group were identified and separated from the Roraima Formation.

A rapid revision was made of the geology of the goldfield areas between Mahdia, the Potaro and Kaburi Rivers, and Issano on the Mazaruni River. The presence of the Mazaruni Group of volcanic and pyroclastic rocks with some associated sediments was confirmed. The granites were carefully examined and found to consist mainly of syntectonic plutons, foliated conformably with the rocks of the Mazaruni Group, and late-tectonic cross-cutting plutons with which the gold occurrences are mainly associated. The Ebini Hills consist of compact amphibolites and coarse-grained feldspar-hornblende rock.

A start was made in a new campaign aimed at producing a reconnaissance geological map of the North West District. The mapping of the Georgetown NW degree sheet (No. 0658 NW) was completed in the Supenaam-Groete Creek-Blue Mountains area and extended up the Cuyuni River to Kutuau River mouth. The rocks of the Barama Group were recognized throughout as metasediments and metavolcanics of varying degrees of metamorphism, steeply folded with a general east-west strike: they contain interbedded manganiferous phyllites and gondites. In the Quartzstone and Kutuau areas volcanic rocks of low metamorphic grade are believed to belong to a younger group and to occupy tight synclines in the Barama Group. In addition to the syntectonic Bartica Migmatite group, late-tectonic plutons were mapped and are believed to be responsible for gold mineralization. In the lower Barama and middle Waini Rivers the rocks were found to consist mainly of phyllites, tuffaceous phyllites, tuffs and quartzites affected by low-grade regional metamorphism, and invaded by biotite and biotite-muscovite granites.

The origin of the alluvial columbite in the Morabisi basin was investigated. Only small crystals of columbite were found in the pegmatites now outcropping, and it is thought that the bulk of the columbite fragments recovered by dredging have probably been through two or more cycles of deposition. A study was made of the present possibilities of the Mahdia goldfield and attention called to the potential value of the "Proto-Mahdia" channel. The diamond workings of the Mazaruni River were visited in an attempt to advise on means of increasing the output of diamonds by the small worker.

Short accounts of the year's field work appear under the writers' names in Appendix I.

GEOPHYSICAL SURVEYS

In September, Dr C.H.G. Oldham of the California Exploration Company, a subsidiary of the California Oil Company, arrived to carry out a gravity meter survey according to a programme previously worked out in conjunction with the Geological Survey Department. The purpose of this work, which was part of a survey covering the whole of South America, was to provide a tie-in with the offshore seismic survey carried out by the same company over part of the continental shelf of British Guiana, and the results of the whole survey were to be made available as a contribution to the International Geophysical Year.

Accompanied during part of the time by Mr R.C. Sansom, gravity meter readings were taken at 81 stations along the coast roads between Charity on the Pomeroon, and Skeldon on the Corentyne River. A flight by Grumman amphibian was arranged over the Interior and readings were made at the following stops - Bartica, Mackenzie, Kwakwani, Apoteri, Orinduik, Kaieteur, Tumereng, Aurora and Barama Mouth. Heights and co-ordinates of all observation points were supplied by the Department.

POLLEN ANALYSIS

Prospecting for bauxite beneath the cover of the White Sand Formation has been very active in British Guiana for a number of years, and in 1958 Exclusive Permissions over the White Sand Formation amounted to some $2\frac{3}{4}$ million acres. The method of scout drilling is generally used and mining companies have found difficulty in correlating the strata encountered in neighbouring boreholes. The White Sand Formation is a continental deltaic type of sediment and consequently the alternating clay, sandy clay and sand beds composing it are lenticular in nature and may lens out rapidly. If recognizable horizons with a wide lateral extent could be found the boreholes could be spaced much more widely and a great saving thus effected in prospecting costs.

With a view to helping the bauxite mining companies to solve this problem the Geological Survey decided to apply a method of correlation which has been much used by oil companies in recent years. This method depends on identifying the pollen grains present in many types of sediments and so establishing correlatable horizons. An approach was therefore made to Dr T. van der Hammen, Palaeobotanist to the Instituto Geologico Nacional at Bogotá in the Republic of Colombia, a well-known expert on pollen analysis. After examining some test samples from British Guiana Dr van der Hammen agreed to undertake the work and the Director of the Instituto Geologico Nacional very kindly allowed him a month's leave to examine the problem in the field.

Dr van der Hammen visited a number of the key areas in British Guiana in the company of Mr D. Bleackley between the 10th and 30th November. He collected over 200 samples for examination at Bogotá and will report on them in due course; the study of the samples is a lengthy business and will have to be done in his spare time. Before the end of the year Dr van der Hammen had done enough work to be confident that he can let us have results which will be of value to the bauxite companies.

Thanks are due to the Demerara Bauxite Company, Limited, and to the Reynolds Metals Company for providing hospitality and transport for Dr van der Hammen and Mr Bleackley during this investigation. The Director of Agriculture kindly arranged for Dr van der Hammen to be shown types of vegetation in the vicinity of Georgetown, and the Conservator of Forests permitted pollen samples to be taken from his herbarium.

TOURS OF INSPECTION

The Director

In January a reconnaissance flight was made in the Grumman amphibian aircraft of British Guiana Airways to test a landing pool at the junction of the New and Oronoque Rivers which was believed to be suitable as a base for an expedition to the relatively unexplored country in the southeastern corner of the Colony. The pool had been used by a small amphibian to supply the British Guiana-Brazil Boundary Commission and was found to be adequate, even at extreme low water.

An invitation on the part of the Reynolds Metals Company to visit their Kwakwani Mine was accepted in February and a most pleasant three days were spent examining the mine and visiting areas in which prospecting for bauxite was in progress. Discussions were held with Mr R. Devlin, Manager and Mr W.E. Bradford, Resident Geologist.

In May a visit was paid with the Deputy Director to the Mahdia and Tumatumari area where Mr J.H. Bateson, Geologist, and Mr L.L. Fernandes, Assistant Geologist, were working. This is one of the most important gold producing areas of the Colony and means for reviving the industry were discussed. The Director was entertained by Mr O.H. Senior, General Manager of British Guiana Consolidated Goldfields, Limited, and visited the company's dredging concession.

The hospitality of the Reynolds Metals Company was again enjoyed in July when a visit was paid with Mr D. Bleackley, Senior Geologist, to the Company's Exclusive Permissions in the Epira-Orealla area on the Corentyne River. Mr Paul Bennett, Geologist in charge, acted as guide.

Several visits were paid during the year to the workings of the Demerara Bauxite Company, Limited at Mackenzie and Ituni.

In November, a tour of the Bartica area was made with Dr Schilling, a newly-appointed Chemist-Petrologist.

The Deputy Director

On January 6th and 7th, a visit was paid to New Amsterdam to consult with the District Geologist there on the compilation of the final map of the Southern Savannas and on the preparation of the report describing the geology.

From 7th to 22nd March the Deputy Director went on field inspection in the Supenaam river area. One week was spent with Mr J.W. Lloyd examining the geology of the area, and the second week was spent with Mr O. St. John at the locality where the latter was carrying out detailed prospection of the kyanite deposits.

In May the Director was accompanied on a tour of inspection of the Mahdia area where Mr J.H. Bateson had been mapping the volcanic rocks and re-examining their stratigraphy and their relations with certain intrusive rocks which abound in the Potaro area generally. Also in the Mahdia area, Mr L.L. Fernandes was carrying out a survey of the alluvial terraces and eluvial gold deposits of the Mahdia valley.

IV. MINERAL DEVELOPMENT

SUMMARY

The first practical attempt to test the oil possibilities of British Guiana's continental shelf was made in 1958. The California Oil Company (British Guiana) Limited arranged for a marine seismograph survey of their offshore lease to be carried out on contract.

In spite of the decreased demand for bauxite the mining companies were able to maintain a high level of exploration activity throughout the year.

Preparations on behalf of the Northwest Guiana Mining Company, Limited, for mining and shipping manganese ore from the Matthews' Ridge deposit continued at full pressure throughout the year.

The gold mining industry received a setback through the closing down of British Guiana Consolidated Goldfields, Limited, in the last quarter of the year.

The United Kingdom Atomic Energy Authority established a branch office in the Colony to stimulate search for radioactive minerals and other minerals ancillary to the nuclear power industry.

BAUXITE

General

In spite of the world wide recession which severely affected the bauxite industry exploration by the mining companies continued actively.

Demerara Bauxite Company, Limited

Production was lower than in 1957 owing to a reduction in the demand for aluminium and calcined bauxite in the world markets, and construction of the W.I. $60,000,000/alumina plant was also slowed down. Manpower and equipment thus released were made available for exploration under a team which consisted of two qualified geologists under the experienced leadership of the Chief Geologist. Exploration was carried out over six Exclusive Permissions, a total area of 1,645,502 acres was given up on completion of prospecting and a new area of 130,000 acres applied for on the left bank, Demerara River, south of Great Fall. A diamond drilling programme in the Yurowa area was completed, and prospecting by surface methods, Empire drilling and pitting was carried out on both banks of the middle course of the Demerara River, in the Deriri area, south of Iron Mountain between the Demerara and Berbice rivers and towards the Corentyne River.

Later in the year altimeter levelling was introduced which should provide additional valuable topographic information in the areas surveyed.

Geological Survey Department

A senior geologist is now making a special study of the geological setting of the bauxites and bauxitic laterites of British Guiana with a view to developing principles which may help in prospecting for further commercial deposits. Microscopic, differential thermal analysis and x-ray methods are being used to study the petrology of the deposits and an attempt is also being made to date them by means of pollen analysis.

In collaboration with Dr Thomas van der Hammen (page 10) close sampling of the sections exposed in the mines at Mackenzie and Kwakwani was carried out and a number of lignites were sampled for C14 age determination. The Forestry Department co-operated in this work by supplying a large number of recent pollen samples extracted from plants in their herbarium to enable the present vegetative pattern to be established.

Reynolds Metals Company

Owing to the depressed state of the market this company was obliged to restrict its exploration activities somewhat, but the number of geologists employed on their British Guiana project was maintained at two for most of the year.

In the Corentyne section an extensive road building programme was carried out to maintain exploration drilling with Solite and Mayhew drills in the Canje area where a semi-permanent base camp was set up. A discouraging factor here is the great thickness of overburden, reaching 160 feet or more.

In the Kwakwani area a considerable amount of drilling was carried out around the known deposits of 27 Mombaca, 24 Green Creek and Ridge 1 and 111 in the Wong lease. A canal was excavated from the Berbice River to a point nearer the mine plant to allow direct loading of the barges.

Harvey Aluminum Inc.

This company retained a total of 1,078,900 acres of Exclusive Permissions throughout the year, and continued compilation of its field records.

CHROMIUM

Anglo-American Min-A-Metals, Limited

No work took place on the Exclusive Permission for chromium granted this company in the Merume River basin and it was therefore declared abandoned.

CLAY MATERIALS

A Swedish company made enquiries about clays suitable for a pottery industry and samples of the types occurring in quantity in the Colony were collected and despatched.

Experiments were continued under the direction of the Minor Industries Officer, in the pilot plant set up by the Government, on the blending and firing of local clays and examples of the products have been placed on exhibition.

COLUMBITE

Columbium Corporation

A 22½ mile road was completed into the Pilgrim Creek area and transportation of equipment for use here commenced.

Exploration and prospecting continued higher in Pilgrim Creek and in Tiger Creek. A workable deposit is said to have been located in E.P. 515 and a portable recovery unit is about to be moved in. Dredging operations were curtailed owing to major breakdowns and time lost in floating the dredge over a granite bar.

DIAMONDS

General

Towards the end of the year a promising find was made in the Kurupung River above Kumerau Falls and the returns from this area were responsible for an increase in total production of some 4,000 carats over 1957.

B.G. Diamond Mining Corporation, Limited

A Swiss-made jet pilot dredge was purchased and put into operation in the Meamu River early in the year, but the results were disappointing mainly owing to the high level of the river and fast currents. The dredge was subsequently moved to Apaiqua and later in the year water conditions became more favourable. It was found, however, that the machine was unable to cope with the deposits here which are at considerable depth and a machine of higher capacity is now on order.

GOLD

B.G. Consolidated Goldfields, Limited

A considerable amount of prospecting was carried out under the direction of two Colonial Development Corporation geologists in the Mahdia valley, the Potaro River above and below Tumatumari, and at Konawaruk. Gold possibilities in the 'proto-Mahdia' - a former channel of the Mahdia River were considered to be promising.

In the lower Potaro intensive Banka drilling disclosed good gold values associated with several old channels of the river. The drilling also showed possibilities for the recovery of diamonds from the base of the White Sand Formation and an experienced

consulting engineer was brought in to recommend modifications to the dredges to enable this to be done.

However, towards the end of the year Colonial Development Corporation decided to exercise its power under the existing debenture agreements and appoint a Receiver and Manager. Active operations were then suspended and the dredges and buildings placed on a 'care and maintenance' basis.

Marina Minerals, Limited

Owing to low water the company was unable to move its dredge from the Marina River to Arakaka Creek where there are stated to be continuous values, and work continues in an attempt to locate gold values beneath a sand reef.

Geological Survey Department

Geological Survey parties were working in the Konawaruk, Mahdia, Potaro River, Kuribrong, Apanachi, Kaburi and Issano areas during the year on a special attempt to locate promising gold areas within reach of the hydroelectric power station recently completed by the Colonial Development Corporation at Tumatumari. Work on some of the indications found was continued by the geologists of B.G. Consolidated Goldfields, Limited, and the 'proto-Mahdia' channel area, for instance, was reported as promising.

A brief study of the terraces and the distribution of gold in the Konawaruk valley was made by two geologists of the department. Several levels of terrace were defined which were correlated between Long Falls and Willis' Landing and the need confirmed for more comprehensive and detailed prospection of them by means of a banka drilling campaign.

A local company has been formed to exploit the shell from several beaches along the Northwest coast. The main beach known as Shell Beach, has been reserved by the Government but this company hopes to work numerous other smaller beaches when an Exclusive Permission has been granted.

Northwest Guiana Mining Company, Limited

Work progressed during the year on steel framed buildings for offices, staff quarters and plant as well as on roads in and around the Matthews' Ridge deposit.

It is planned to rail the ore 28 miles from the mine to a turning basin on the Haituna River where it will be loaded into self-propelled barges shuttling to Trinidad. Earthworks for the 28-mile railway have now

been completed from the Kaituma River to the Barima and the track is at present used by vehicles for access to the mine. Piling for the Barima Bridge has been finished and earthworks commenced on the opposite bank of the river. Production is now expected to begin early in 1960.

Prospecting at Tassawini Ridge continued until February when the work was terminated, as drilling, pitting and trenching had shown the deposit to be of low grade. On completion of this work the Company's geologist went on leave and eventually resigned, so that no further surveys were carried out until a new geologist arrived in October and prospecting over the company's holdings of 2,358,497 acres was resumed. Work was carried out west and southwest of Matthews' Ridge and will be pursued as far as the Venezuelan border.

OIL

California Oil Company (British Guiana) Limited

An exploration lease over the coastal and offshore areas of British Guiana was granted to this company early in the year and from July to September a marine seismograph survey was completed over the continental shelf as far as the 25-fathom line. The work was done under contract by the Western Geophysical Company and approximately 3,000 reflection seismograph stations were recorded and six refraction seismograph profiles taken at strategic locations. Continuous positioning information was provided by Offshore Raydist Incorporated who established seven coastal stations. The records are now being studied by the geophysicists of the company and a report on the first results is expected in 1959.

In November a geologist of this Company spent five days on a reconnaissance of the coastal area of the North West District investigating reports of oil seepages and pitch deposits.

RADIOACTIVE MINERALS

The United Kingdom Atomic Energy Authority took the welcome decision in 1958 to establish an office in Georgetown. A geologist arrived in June and by November a small office building with a laboratory and store was ready for occupation in the Geological Survey Compound. The geologist visited many of the Geological Survey field parties working in promising areas in the Colony before the year was out and obtained much useful information. An occurrence of radioactive material discovered on the line of the railway under construction between the Kaituma River and property of Northwest Guiana Mining Company, Limited, was examined in some detail by ground and airborne surveys but proved to be euxenite - a refractory mineral. The search is being extended to beryl, lithium minerals and so forth, required in the nuclear power industry, as well as to radioactive minerals.

V. WATER SUPPLY

THE COASTAL ARTESIAN BASIN

An account of the Coastal Artesian Basin of British Guiana which feeds the wells of the Pure Water Supply was given in the Annual Report for 1957. During that year the Government arranged for an examination of the potential supply of this basin to be carried out by a senior hydrologist generously lent by the United States Geological Survey under the auspices of the International Co-operation Administration. A study of the basin was felt to be urgent because of an apparent drop in the hydrostatic head of the wells which might have been due to overdepletion of the reservoir and could possibly lead to the intrusion of saline water into the wells owing to the proximity of the sea. The subsequent report by Mr G.F. Worts, Jr., was published in 1958 as Bulletin 31 of this department. In view of Mr Worts' report, recommendations for a further investigation of the water supply potential of the coastal artesian basin were discussed by the Standing Committee, Pure Water Supply, and submitted to Government. The Drilling Superintendent, Pure Water Supply, and the Director, Geological Survey Department, were requested to implement these recommendations. Six automatic water level recorders are on order, and arrangements have been made for the quarterly sampling and analysis of 12 representative wells as a measure to detect any saline intrusion.

A post of Geophysicist-Hydrologist was added to the establishment of the Geological Survey from 1st January, 1958, and Dr L.E. Ramsahoye, B.Sc., D.I.C., Ph.D. (London), who had been recruited during the previous year as temporary geologist, was transferred to this post. Dr Ramsahoye immediately started investigations with a view to determining the three-dimensional shape and physical properties of the artesian aquifer as the most important factors governing its capacity. It will be recalled that the artesian basin consists of at least two aquifers, the upper sands and the "A" sands. It is the latter horizon which is tapped by the wells of the Pure Water Supply. The recharge of both these aquifers is supplied by rain water which falls on the White Sand Formation of the Interior and percolates down below the coastal clays, but in view of the fact that the aquifers are separated by impervious clay bands it is possible that the recharge area of each may be quite distinct. In order to estimate the potential flow in the water-bearing horizons it is necessary to know the size of the recharge area. With a view to determining this area, Dr Ramsahoye, assisted by Mr R.C. Sansom, Assistant Geologist, carried out an extensive investigation with a Craelius electrical resistivity apparatus which was aimed at determining the relative thickness of sands and clays in the recharge area. An account of this work is given below and it is shown that, owing to the rapid lateral variation in the clay lenses intercalated in the White Sands, this method did not yield satisfactory results.

During the period mid-July to mid-October, Dr Ramsahoye made a study tour in the United States which was kindly arranged by the United States Geological Survey and supported by the International Co-operation Administration. During this tour visits were paid to artesian basins in the eastern United States which bear some resemblance to our coastal artesian basin. Much progress has recently been made in the study of the relative position of the fresh water/salt water interface. It is found that the position of this interface is different if the state of equilibrium is static or dynamic. It appears that if a state of dynamic equilibrium between the flow of fresh water recharge in the aquifer and sea water can be postulated then the danger of saline intrusion is not so great. From purely geological considerations developed during the recent study of the coastal sediments of British Guiana by this Department (see Bulletin 30, "The geology of the superficial deposits and coastal sediments of British Guiana" by D. Bleackley, M.A., F.G.S.), such a dynamic equilibrium appears very likely and in view of the great extent of the recharge area of the White Sand Formation, its extremely porous nature and the high local rainfall, it would appear that the water supply capacity of the coastal artesian basin must be very considerable. Dr Ramsahoye is now carrying out an active programme of investigation and the results will be reported shortly.

During the course of the investigation of the coastal artesian basin the Drilling Superintendent, Pure Water Supply, was constantly called upon for advice and assistance and has made a great contribution to our work.

FIELD WORK

The field work carried out by the Geophysicist-Hydrologist is reported on as follows:

PRELIMINARY RESISTIVITY INVESTIGATIONS ON THE WHITE SAND FORMATION, 1958

By L.E. Ramsahoye, Geophysicist-Hydrologist
and R.C. Sansom, Assistant Geologist.

Typical boreholes on the coast of British Guiana reveal two distinct artesian sand reservoirs in the Berbice or White Sand Formation which are separated from each other by a thick impermeable clay. The upper reservoir known as the "upper sands" generally contains water which is too brackish for human consumption. The lower reservoir, known as the "A Sands", contains water of a very good quality, and this has led to its extensive use for supplying the coastal districts with pure water.

Recently, because of an apparent decline in water levels in the coastal wells, it has been decided that some hydrological investigations should be undertaken so that the safe yield of this lower aquifer may be estimated. For this to be done it is of primary importance that the recharge or catchment area of this aquifer be reasonably well defined. The impermeable clay, known as the "intermediate clay", separating the two aquifers has no known distinguishable outcrop in the white sand region of the Interior. Thus, although the catchment area of the two aquifers as a whole is quite well defined from aerial photographs, no distinctions can be made as to the respective recharge areas for the aquifers. It is natural to assume, however, that the intermediate clay has a sub-outcrop which has been covered over by white sand thus preventing its discovery by the normal geological methods. Unfortunately, also, little or no borehole data is available in the area of interest.

Hence it was decided to employ geophysical methods in an effort to locate this clay sub-outcrop and thus define the recharge areas of the two reservoirs. For this type of work, the resistivity method seemed to be the most reasonable - for in addition to being one of the cheaper geophysical methods it has proved to be very successful in investigating shallow sedimentary deposits. The clay could be located by its low resistivity compared with high resistivity of surrounding sands.

Accordingly it was decided to make a series of traverses starting from Makauria on the right bank to the Essequibo River, across to Sand Hills on the Demerara River. The existence of quite a few small roads in this area made it particularly desirable for the start of this work.

The resistivity equipment used was a 'Craelius' instrument in which a low frequency a.c. generator is

used to supply energy to the two current electrodes. The p.d. between the potential electrodes is measured by a valve amplifier. The apparent resistivity is found by comparison of this p.d. with that produced by standard resistances within the instrument.

The initial investigations at Makauria using the expanding Wenner electrode system showed quite irregular curves suggesting the presence of lateral discontinuites. A change over to the Lee electrode system confirmed the presence of lateral disturbances. As the survey continued it became evident that the presence of lateral anomalies was quite a general feature and that only in a very few instances was it possible to make any depth determinations. It should also be noted that this is consistent with the accepted deltaic origin of the sediments, as such a cycle of deposition would inevitably show rapid lateral changes in facies. Nevertheless in two areas (at Sulphur Creek and near De Freitas' Quarry) good resistivity curves were obtained which gave depth estimations very close to the expected values.

Some traverses using constant electrode separations were also done. Here again the existence of lateral changes apparently quite near to the surface (50 feet) prevented the tracing of sand or clay horizons.

It must be concluded that generally the presence of numerous lateral anomalies (e.g. clay lenticles and lenses within the sand) prohibits the use of resistivity methods for depth estimations. In special instances however, where there is some reasonable degree of lateral homogeneity, the resistivity measurements can give accurate depth determinations, but these conditions are so rare in the White Sand region that it would be uneconomic to use resistivity methods on a large scale. It would appear that from the type of sedimentary deposit that exists only borehole information can be relied upon.

It should be mentioned, however, that the resistivity results can be used for the location of the water table, as this is generally above the interfering lateral anomalies. Some caution has, however, to be observed in tracing the water table by the normal constant electrode separation method in open country. This is because rapid evaporation causes tremendous changes in surface resistivity as the day progresses. It would thus be necessary to check measurements during the day by the expanding electrode system.

A resistivity expedition was also carried out at Mackenzie, the idea being to obtain an order of magnitude of resistivity of the various types of sands and clays, to see whether it would be possible to distinguish between them electrically. Mackenzie was chosen because of measured sections and borehole information available in that area.

Once again lateral changes make the interpretation difficult. It would be necessary to adjust the data by "smoothing" the curves before some interpretation can be done. This part of the work has not yet been completed.

VI. HEADQUARTERS

ADMINISTRATIVE OFFICE

The reorganization of the headquarters administrative office was described in last year's Report and has proved very successful. The Chief Clerk and Class I Clerk in charge of accounts are to be congratulated in dealing so successfully with the additional work caused by the great increase in staff and the process of centralization; they have willingly put in a good deal of overtime. The Chief Clerk has assumed responsibility for administrative matters involving junior staff, stores, maintenance of buildings, the supply of field expeditions with stores and spare parts, and has relieved the Director and Deputy Director of routine work in many other ways. Under the Class I Clerk the accounts have run very smoothly; apart from the routine central accounting, each field expedition has a separate set of accounts and the influx of new recruits unfamiliar with local accounting procedure has been handled with skill and tact.

The new publications room has brought a great improvement in the facility for reproducing those departmental publications which are out of print but still in continual demand. The room is equipped with an electric typewriter and an electric Gestetner duplicating machine. Illustrations are duplicated on a Gestetner photoscope in a special air-conditioned darkroom. During the year the following publications were duplicated:-

(a) Annual Report for 1948

(b) Bulletin No. 1

(c) " " 23

(d) " " 24

(e) Mineral Resources Pamphlet No. 6

The Secretary, who was transferred from the Ministry of Labour, Health and Housing and assumed duty on 23rd June, is to be congratulated on learning the language of geology in remarkably quick time. In addition to dealing with the Director's correspondence she has undertaken responsibility for the filing of geologists' reports and other technical papers. The entire staff has dealt with the increase in work in a most praisworthy fashion.

LIBRARY AND RECORDS

In view of the importance of an efficient library to the Geological Survey a new post of Supervisor of Library and Records was instituted this year. In addition to the task of indexing the contents of the library and supervising loans this officer is also in charge of the unpublished technical reports and records of the Department accumulated since its foundation. It is intended to compile indexes of all this material so

that any information required will be readily accessible to officers of the Department and the Public. There will be a Mineral Index recording every reported occurrence throughout the Colony of each mineral of possible economic value, and a Degree Sheet Index in which all published and unpublished maps and reports, mines, prospects, mineral occurrences and other facts of interest will be recorded in respect of each geographical degree square.

Mr H.K. George was appointed to the new post on 15th April and has achieved a very great improvement in the library services in this time. Practically all the publications in common use are indexed and can be readily found by readers, for whom a simple method of recording loans has been introduced. A number of the most important technical and scientific periodicals are on subscription and members of the Department are thus enabled to keep in touch with all the latest developments in their profession. A magazine rack has been installed to display the latest numbers, and back numbers are readily accessible. The following figures show the progress of the work during the year:-

Total stock of books, magazines, etc.	4,500
Number indexed up to 31.12.58	2,200
Number of Books in Library	600
Articles and Periodicals indexed	93
Periodicals received regularly	42
Total new accessions in 1958	337

The Supervisor of Library and Records is also in charge of the sale and distribution of publications and the following statistics refer:-

Maps sold	132
Other publications sold	373
Free distribution of maps	21
Free distribution of other publications	643
Issues on loan during 1958	338
Number still on loan at 31.12.58	227

New publications of the Geological Survey are widely distributed on a free list throughout the world and in return, we receive much more than the value of these in free exchange. In addition the steady demand for back numbers and cyclostyled editions of out-of-print publications is shown by the following figures for revenue from the sale of our publications during the past three years:-

1956	$557.25
1957	459.89
1958	570.65
	$1,587.79

DRAWING OFFICE

On the Drawing Office of a Geological Survey rests a very great responsibility. During field expeditions the geologists record most of the geological, topographical and general information acquired on provisional maps and much of this can be lost to our records, and is in fact only too often lost or overlooked if there is not an efficient Drawing Office staff to compile and redraw the field information at a uniform scale and then classify, file and index the maps so that any facts can be readily found when required. The overseas prestige of a Geological Survey also depends very much on the quality of the maps which are published and distributed. Well-prepared and professionally authoritative maps can have a great influence in attracting mineral exploration effort, particularly to-day when prospecting methods depend largely on accurate geological information.

With the expansion of the Geological Survey a reorganization of the Drawing Office became necessary and a new post of Drawing Office Supervisor was approved in the 1958 Estimates. The Department was fortunate in securing the services of Mr T.M. Rahaman who has had 10 years drawing office training and experience with oil companies and the Government Petroleum Engineer in Trinidad. Since his appointment on 10th August he has brought up to date the systems for filing and indexing air photos, maps, plans and field originals, and placed modern drawing office equipment on order in preparation for occupying the new drawing office which was nearly ready at the end of the year. Work was also started on the preparation of a series of base maps for the whole Colony in accordance with the geographical degree square system.

The permanent Drawing Office staff now consists of two Senior Drawing Office Assistants and three junior assistants. In addition some 14 Field Observers and Field and Office Assistants worked on a temporary basis during the year. These men work in the Drawing Office on their return from field expeditions preparing maps showing the work accomplished during the expedition; the standard of these maps has greatly improved under expert direction.

WORK ACCOMPLISHED

During the year 144 maps were either drawn, compiled or traced. These included no less than nine quarter degree squares which were either compiled or interpreted from Print Laydowns. 30 photoscopic stencils were made, maps produced from these stencils were bound mainly in cyclostyled publications of this Department.

Five hundred and sixty-eight Ammonia Sunprints, using 1,650 sq. ft. of paper, were made. Twenty-five per cent of these prints were hand-coloured.

LABORATORY

An essential element in the present expansion of the Geological Survey Department was the provision of greatly improved laboratory facilities, not only for purely departmental work, but to provide a much-needed service for the public. It was realised that a considerable amount of reorganization would be involved and therefore a new specialist post of Chemist-Petrologist was introduced. This was filled in June by Dr J. Schilling, who was trained in Germany and Switzerland and possesses much practical experience in the fields of both chemistry and petrology. Under his control the laboratory has attained a high standard of efficiency and plans are being drawn up for a re-arrangement of the building which will enable much more work to be undertaken.

Work in the laboratory has been carried out under difficulties this year owing to the construction of the new office wing. Supplies of gas, water, and electrical current were cut off periodically and the dust from construction interfered with accurate chemical analysis. Nonetheless some important work was carried out for a large gold mining firm and for other members of the public. The officers of the Department were well served with regard toidentification of minerals and assistance with the study of the rock types encountered in their map areas. A "Mottacutta" machine for slicing rocks has been installed and has speeded up the production of thin sections. The work carried out during the year was as follows:-

Thin sections cut	- 805
Analyses and determinations for the Department	92
Mineral preparations, sieve Analyses, etc. for the Department	- 227
Work for private persons, companies and other Government departments	91

Field Work

The Chemist-Petrologist intends to carry out a certain amount of field work each year, in addition to his headquarters duties and he will visit the field areas of any geologist who requires his assistance. He has been asked to make a special study of the old Precambrian shield rocks of the Kanuku and South Savanna degree sheets of the Rupununi District and advise on their classification in mappable formations. A migmatite series, culminating in an anatexic granite, appears to be present; and the rock types are complicated

by the presence of a group of charnockitic granulites and hypersthene granites which may represent an older metamorphis series.

A visit was also paid to the Bartica area in the company of the Director and the evidence reviewed for the derivation of the Bartica Migmatite group from the metamorphic rocks of the Barama Group by Mr R.T. Cannon.(1)

(1) "The geology of the Camaria-Kartabu-Dalli Area" by R.T. Cannon. Ann. Report for 1956, Geol.Surv. B.G., Georgetown, 1957.

VII. PUBLICATIONS AND REPORTS

The following were published during 1958:

Annual Report for 1957.

Bulletin No. 31: "A brief appraisal of ground-water conditions and proposed program for water resources investigations in the Artesian Basin of British Guiana" by G.F. Worts, Jr., U.S. Geol. Surv.

Sent to the press:

Bulletin No. 27: "Gold Deposits of the Cuyuni River" by R.T. Cannon.

Cyclostyled editions of the following were issued as the original had gone out of print:

Bulletin No. 1: "Kaburi District". By D.R. Grantham, S. Bracewell and G.J. Williams.

Bulletin No. 23:

"1. Manganese deposits in the North West District, British Guiana.

2. Reconnaissance report on Kurupung Diamond Field, Mazaruni District, British Guiana.

3. Progress report on Kurupung Placers Company, Ltd. Kurupung River, Mazaruni River District, British Guiana.

4. Reconnaissance of the Alex Hill and Mad Kiss Mines, Cuyuni Goldfields, Aurora District, Cuyuni River, British Guiana."

By B.N. Webber, U.S. Geological Survey.

Bulletin No. 24: "The Diamond & Gold Resources of the Mekuru District, Cuyuni River". By E.R. Pollard.

Annual Report for 1948.

Mineral Resources Pamphlet No. 6: "Monazite in the Rupununi District British Guiana". By R.A. Dujardin.

The following unpublished reports and maps were prepared:

R. B. McConnell, Director

Memorandum on the mineral potential of British Guiana and its future development. RBM 1/58.

Appendix on mineral localities to be served by the projected road from Bartica to Lethem. RBM. 2/58.

The Takutu Formation in British Guiana and the probable age of the Roraima Formation. RBM 3/58.

D. Bleackley, Senior Geologist
& O. St. John, Field Observer

Supply of shell for use as agricultural lime in British Guiana. DB 1/58.

Plan of a portion of the sea coast showing shell accumulations.

P.B.H. Bailey, Senior Geologist

Report on a gold locality 7 miles south of Akaiwong Landing, Cuyuni River. PBHB 1/58. With L.L. Fernandes, Assistant Geologist.

Sketch map of gold workings, 7 miles south of Akaiwong Landing, Cuyuni. With L.L. Fernandes, Assistant Geologist

Field reconnaissance of the Haieka, Kukui and Kako areas of the Upper Mazaruni River. PBHB 2/58.

Reconnaissance map of the Haieka, Kukui and Kako areas of the Upper Mazaruni River.

L.E. Ramsahoye - Geophysicist-Hydrologist

Report on a trip to sea with the P.W.D. Hydrographic Vessel, "Sir Frederick", 16-19 June, 1958. LER 1/58.

C. N. Barron, Geologist
& O. St. John, Field Observer

Report on alluvial kyanite deposits and the structure of the associated schists, Upper Supenaam River. CNB 1/58.

P. I. Morris, Geologist

Map of geological reconnaissance traverses of Upper Essequibo, Lower Rewa and Lower Rupununi. 1/125,000.

J.H. Bateson, Geologist

Report on the Mahdia-Konawaruk Expedition, February, 1958. JHB 1.58

Geological reconnaissance map of the Apanachi area (Potaro NE). 1/100,000.

Map of the Mahdia-Konawaruk Expedition, February, 1958. With M.G. Allderidge, Assistant Geologist.

J.W. Lloyd, Geologist

Report on the geology of the Supenaam River area, 1958. JWL 1/58.

Geological map of Supenaam River - Essequibo River (Georgetown SW). 1/125,000.

Geological map of Groete Creek, 3" = 1 mile.

Geological map of Ecribisi - lower Cuyuni. 2½" = 1 mile.

Geological map of Mariwa-Tipuru area. 1/63,360.

Geological map of Ukuau-Middle Cuyuni. 1/63,360.

M.G. Allderidge, Assistant Geologist

Report on the pegmatites of the Robello Creek area and the origin of columbite in the Morabisi basin. MGA 1/58.

Prospection plan of Young Creek, Mazaruni River. 1/2,000 (with accompanying diagram).

L.L. Fernandes, Assistant Geologist

Report on a visit to the Mahdia Goldfield, Potaro District, 1958. LLF 1/58.

Plan of Mahdia Goldfields. 1/25,000.

O. St. John, Field Observer

Report on the prospection of the kyanite deposits, Camp Creek, Supenaam District, British Guiana. 1" = 500'. OStJ 2/58.

M.W. Carter, Assistant Geologist

Geological map of Muruwa-Konawaruk. 1/100,000.

Geological map of Annai-Kurupukari. 1/100,000.

A.O. Edwards, Field Observer

Plan of bauxite mine. 1" = 1,000'.

Longitudinal sections of Montgomery Mine. 1" = 2,000' and 1" = 30'.

APPENDIX I

PRELIMINARY GEOLOGICAL REPORTS

C O N T E N T S

		PAGE
A.	Field reconnaissance of the Haieka, Kukui and Kako areas of the Upper Mazaruni River, by P.B.H. Bailey, Senior Geologist.	31
	Geological reconnaissance of Makarapan and parts of the Essequibo, Rewa and Rupununi Rivers, by P.I. Morris, Geologist.	32
C.	The Mahdia-Konawaruk area, 1958, by J.H. Bateson, Geologist.	34
D.	Kaburi-Issano area, Mazaruni River, by J.H. Bateson, Geologist, and M.G. Allderidge, Assistant Geologist.	36
E.	Supenaam River-Groete Creek area by J.W. Lloyd, Geologist.	37
F.	The Lower Cuyuni River by J.W. Lloyd, Geologist.	39
G.	Area northwest of Quartzstone Landing, Cuyuni River, by J.W. Lloyd, Geologist.	40
H.	Geology of the country around the Lower Barama and Middle Waini Rivers, August-November, 1958, by K. Bramley, Geologist.	41
I.	Muruwa-Konawaruk area, by M.W. Carter, Assistant Geologist.	44
J.	The Annai-Kurupukari survey by M.W. Carter Assistant Geologist.	47
K.	Origin of the columbite of Robello Creek, Morabisi River, by M.G. Allderidge, Assistant Geologist.	49
L.	Preliminary report on a visit to the Mahdia Goldfield, Potaro District, by L.L. Fernandes, Assistant Geologist.	50
M.	A tour of the Mazaruni Mining District, by L.L. Fernandes, Assistant Geologist.	52

A. FIELD RECONNAISSANCE OF THE HAIEKA, KUKUI AND KAKO AREAS OF THE UPPER MAZARUNI RIVER

By P. E. H. Bailey, Senior Geologist

The field work described took place in the upper Mazaruni drainage in the Pakaraima Mountains of western British Guiana between mid-February and May. Within the area there are long stretches of water navigable for small boats and the Amerindian inhabitants have a few long but far separated walking trails. The survey was based on these communications, and river traverses of the Mazaruni, Kukui and Kako were made to their upper limits of navigation, which were tied to land traverses linking the headwaters.

The Kako, Kukui and Haieka rise in the high mesa-topped country running from Roraima to Ayanganna and flow north into the Mazaruni. On the north bank of the Mazaruni an area was surveyed near Imbaimadai in the neighbourhood of the Partang and Karaurieng, which flow southwest off the Merume mountains.

The area surveyed is underlain by members of the Roraima Formation and their intercalated gabbro intrusives. The Roraima Formation consists predominantly of continental sandstone, not uncommonly arkosic, with subordinate conglomerates and quartzites with minor beds of shales, cherts and jaspers. The beds of the Roraima Formation and the gabbro sills, which at first sight appear horizontal, regionally show a gentle dip of about 1^{o} to the southwest. A large number of observations on foreset bedding over a wide area indicate a general direction of depositional currents towards the southwest, so the gentle dips in the same direction previously mentioned would be inconsistent with a natural sedimentary dip. In any case the foreset bedding observations show that for at least one period in Roraima times the source of the sediments was to the northeast in granite or arenaceous regions now completely removed.

Thefiner-grained Roraima sediments appear in stratigraphically high horizons on the southern side of the area. No metamorphosed shales were seen, but in the upper Kabaik, a Haieka tributary rising on Ayanganna, a metamorphosed banded rock was taken to be a metamorphosed shale. Well-bedded cherts were seen in places on Yaiwoktipu on the western side of the Arabaru; elsewhere chert and jasper pebbles and boulders appeared in the bed of the upper Arabaru below Maringama and at Korlumeduwah rapid on the Kako. A jasper from the last locality appears to contain fossil material and awaits expert examination. The chert beds in situ alternate with sandstones and this, together with delicate current bedding in some of the cherts, make deep water conditions at the time of sedimentation unlikely.

The gabbros occur in sill or laccolithic form, never as dykes. They appear to be in two major conformable structures. The first, a continuation of the sill mapped by Martin-Kaye in 1952 in the Kamarang, extends up the Mazaruni to Meseta rapid and a considerable way up the Kukui. This overlies the sandstones and conglomerates further up the Mazaruni. The second body overlies the

Chinowieng-Chi Chi sandstone and conglomerate surface, outcrops at various points up the Haieka and Kabaik and dips to the southwest outcropping around the upper Kukui basin, to disappear below the Lobi escarpment. This is possibly a laccolith since it appears to be 200-300 feet in thickness up the Kabaik and about 1000 feet thick in the Kukui head. Gabbro from another intrusive body is encountered at Sala-ekwa near to Arabaru.

Prospecting for gold and diamonds proved disappointing in the Haieka, Kukui and Kako regions, but a brief inspection of the Karaurieng showed gold and good diamond indications in the battel at the foot of a fall above the third rapid. An active diamond working was visited near Sawa Creek, a right bank Mazaruni tributary above the Kukui mouth. In two years several thousand dollars worth of small stones have been extracted. Sufficient gold appeared in the battel to justify collecting but the diggers seem to have made no efforts to recover it.

B. GEOLOGICAL RECONNAISSANCE OF MAKARAPAN AND PARTS OF THE ESSEQUIBO, REWA AND RUPUNUNI RIVERS By P.I. Morris, Geologist.

Parts of the rivers Essequibo (Rupununi mouth upstream), Lower Rewa and Rupununi (mouth to Mora Bend) and Makarapan Mountain were geologically reconnoitred during the first field season mid-February to May, 1958, and a map prepared to a scale of 1:100,000. The main purpose of the survey was to delimit the extent of a reddish to purple, generally undisturbed, predominantly sandstone and mudstone formation known to exist at Apoteri. A subsidiary object was the mapping of Makarapan where a ring structure was suspected. Makarapan consists of a main mountain mass, some 3,000 feet high at the mid-point of a crescent of lower ridges and hills.

The main geological divisions in the area seem to be:

4. Takutu Formation (?)
3. Younger Granites (including Makarapan granite)
2. Volcanics - ? Mazaruni Series
1. Basement Complex

Basement Complex

Rocks referred to the Basement Complex outcrop along the Essequibo River from near Primo's Inlet (20 miles above Apoteri) to King William IV Falls, and in the Rewa River upstream from near Bamboo Creek. Foliation directions along the Essequibo are generally steeply dipping or near vertical, striking generally E-W nearer Apoteri, then swinging slowly in a clock-wise direction to N-S near King William IV Falls. In the Rewa the general strike direction approximates to E-W.

Upstream from Primo's Inlet the rocks are coarse-grained hornblende-biotite gneiss, and biotite gneiss which pass into high grade garnet-sillimanite gneiss near King William IV Falls. In the Rewa River occurs a series of garnet-biotite gneisses often of granitic appearance, rare granulites and bands of tough green impure quartzite containing rounded zircons and sphenes.

Volcanic Rocks

A few miles upstream from Apoteri are a few exposures of volcanic rocks, probably of intermediate composition, striking NE-SW and dipping gently northwestwards. No contacts were exposed but it is possible that the volcanics are overlain unconformably by the Takutu Formation. Other volcanic exposures are confined to rare intercalations of amygdaloidal rock resembling andesite.

Granites

Several granite intrusions exist in the area, the most interesting being Makarapan. The whole of the mountain area is composed of an unfoliated homogeneous intrusion of riebeckite granite some five miles in diameter. The intrusion appears to be confined to the mountain area as more recent information indicates that nearby granite masses are normal hornblende granites similar to those at Toka and Annai. No contacts were detected for on all sides the Makarapan granite disappears beneath superficial deposits but it seems probable that the granite-Takutu Formation contact is a faulted one. Near Apoteri a large hornblende-biotite granite intrusion some 15 miles across, is referred to the "Younger Granites". This is generally unfoliated and similar to hornblende granites in other parts of the Colony.

Takutu Formation

Takutu Formation is the name applied to a series of poorly fossiliferous mudstones and shales with subordinate thin sandstones presumably underlying the greater part of the North Savannas of the Rupununi District and extending westwards into Brazil. The meagre fauna and flora so far collected indicates a Permo-Triassic age for the formation. Micaceous sandstones had been reported near the mouth of the Rewa River and traverses confirmed this and other occurrences; it was established that a gently folded formation of sandstones, shales and mudstones, similar to the Takutu Formation, extends from Apoteri westwards and southwestwards to the North Savannas. No fossils were discovered but in view of the nearness of the North Savannas, the similar physical characteristics of both areas and the close lithological similarity and mode of occurrence of the formations it is probable that the Apoteri-Rewa rocks and the Takutu Formation (in the type area) are lateral equivalents.

Geological Inferences

Several inferences may be drawn regarding the structure of the North Rupununi area as a result of the

survey. If the relationship between the Makarapan granite and the sediments termed Takutu Formation is a faulted one it seems to provide more evidence for the existence of a major fault system along the northern margin of the North Savanna and lends greater evidence to the concept that the North Savannas lie in a graben.

Economic Considerations

Prospecting for gold and radioactive minerals was carried out throughout the survey but apart from a few gold indications in the Essequibo the results were disappointing.

C. THE MAHDIA-KONAWARUK AREA, 1958
By J.H. Bateson, Geologist.

The object of this expedition, carried out from mid-February to May, was to re-examine the areas mapped by Grantham (1935) and Bracewell (1934), particular attention being paid to the sub-divisions of the Volcanic Series and their relationships to the surrounding rocks.

The area consists of basic and acid volcanics and intercalated sediments with a marked northerly regional strike and steep dips. These rocks are cut by much altered older Basic Intrusives and a suite of granites and are overlain by the Roraima Sandstone. All the members up to and including the Roraima are cut by a series of Newer Basic Intrusives. The White Sand Formation rests upon the solid formations over a considerable area.

STRATIGRAPHY

The rocks of the area have been subdivided as follows:-

White Sand Formation
Newer Basic Intrusives
Roraima Formation
Newer Granite Suite
Older Basic Intrusives
Mazaruni Group (formerly Volcanic Series)

White Sand Formation

This formation was not examined in great detail but it was found to be composed of well sorted, white to brown, unconsolidated sands and some mudstones. From some of these mudstones fragmentary fossilised dicotyledonous leaves were obtained.

Newer Basic Intrusives

Rocks varying from coarse noritic gabbro to fine-grained dolerites have been intruded into all the rocks up to and including the Roraima. The dolerites occur as steeply dipping dykes intruded along 070°-120° trends, which vary in size from a few inches to hundreds of feet in

thickness. The norites generally occur as thick relatively flat-lying sills.

Roraima Formation

A series of white to chocolate current-bedded sandstones and quartzites, with occasional pebble bands, lying horizontally on the underlying rocks.

Younger Granite Suite

Granitic rocks occur quite commonly throughout the area and all have been referred to the same group - namely a post-Mazaruni phase of activity. The granites examined are quartz-felspar-hornblende/biotite rocks of variable grain size. Minor variations occur in the Tiger River granite which has locally quite well developed N-S foliations, and in the Konawaruk granite which is much richer in hornblende than the rest, probably due to local assimilation of volcanic material.

Older Basic Intrusives

These are a group of metamorphosed basic dykes and sills intruded into the Mazaruni Group. They are medium to coarse-grained rocks with a distinctly green coloration, some of which have retained traces of ophitic texture. Dykes of these rocks can be seen intruded by the Newer Basic Intrusives.

Mazaruni Group

Lavas, acid and basic, pyroclastics, cherts and intercalated sediments are all represented in this group, the strike of which varies between 340° and 360°. Joints are usually well developed - particularly in the more acid members - with a NE-SW trend.

Fine grain size, green-grey to black coloration, slightly conchoidal fracture and an S.G. of 2.68-2.80 are the chief characteristics of the acid lavas. The groundmass of granular quartz and plagioclase shows, in some examples, well-developed flow banding whilst the phenocrysts are often corroded. The original mafic minerals have been almost entirely replaced by chlorite, epidote and magnetite although in a few instances small fragments of hornblende still remain at the centre of epidote/chlorite patches.

The more basic varieties (S.G. 2.87-2.93) are similarly fine-grained, commonly with feldspar and augite phenocrysts and also containing pyrite as an accessory mineral. The phenocrysts are usually decomposed to sericite in the case of felspars and to epidote, magnetite and occasionally sphene in the case of augite. Typical "pillow" structure was found only in one locality accompanied by red and black cherts which contain a number of rounded structures the origin of which has been tentatively regarded as organic.

Pyroclastic rocks are very subordinate, occurring mainly in the Northfork River area as bands of coarse agglomerate, the fragments being anything from one inch to one foot in diameter. Tuffs have also been identified from the region - rounded and angular fragments of quartz and sericite rock set in a fine grained matrix of similar material.

In the Mahdia valley narrow bands of white to chocolate-brown sandstones occur interbedded with the volcanics. These sandstones show good grading and colour banding with a concentration of magnetite grains often along the bedding planes.

Porphyritic Rocks

These have a fine grained, dark matrix of granular quartz and orthoclase in which are embedded large phenocrysts of pink or green felspar (An_{30}-An_{50}), and euhedral hornblendes, which are usually altered to chlorite, epidote and magnetite. In some examples large quartz phenocrysts occur with the plagioclase and hornblende. Such rocks have formerly been considered both as intrusions (Grantham)(1) or recrystallised tuffs (Seal)(2). New evidence obtained seems to suggest that they are probably related to the Newer Granite Suite.

CONCLUSIONS

No basis was found for the previously accepted subdivision of the former "Volcanic Series" into "Basic" and "Acid" groups - both types of rock occur together.

All the granites are referred to the Younger Granite suite - that is belonging to the same post-Mazaruni phase. It is quite probable, however, that future work on these granites may show that they are divisible into biotite and hornblende granites.

Owing to strong lithological similarity and geological position the volcanic rocks of this area are now considered as the local equivalents of the Mazaruni Group.

D. KABURI-ISSANO AREA, MAZARUNI RIVER

By J.H. Bateson, Geologist, and M.G. Allderidge, Assistant Geologist.

The survey was conducted in the area bounded by the Mazaruni, Kaburi, Kuribrong and Waiamu Rivers during the 2nd field season from August to November, 1958.

(1) Grantham D.R., Petrological Appendix in "The geology and gold deposits of the Potaro" by G.J. Williams, Geol. Surv. B.G., Bull. 3, 1936.

(2) Seal, R.G. 1952. Report on a portion of the Potaro Diamond Field. Geol. Surv. B.G., Ann. Rep. for 1957.

The physical features are largely dominated by the mantle of White Sand that occurs over the area, producing a flat or gently undulating surface at between 300-400 feet. This surface is broken in a few places by groups of steep-sided, laterite capped hills, the highest (Ebini Hills) reaching a maximum height of 1,100 feet. To the north the White Sand has been almost entirely removed and the drainage superimposed upon the underlying solid formations. The stratigraphical succession in the area is as follows:-

STRATIGRAPHY

Superficial Deposits
White Sand Formation
Newer Basic Intrusives
Younger Granites
Mazaruni Group

Mazaruni Group

This group is composed mainly of acidic lavas and tuffs, with some pyroclastics in the west, together with interbedded quartzites.

In general the strike of the group is NW-SE but this direction is disturbed in the south where the strike is mainly northerly and in the southwest where north-easterly directions were observed.

Running across the area between Apanachi River mouth and the Issano River is a band of muscovite/sericite schist which is thought to be closely connected with faulting and movement in this area.

In the Ebini Hills the streams have cut down through a series of compact amphibolites to a coarse grained felspar-hornblende rock. The transition between these two rock types occurs over a small distance, but no relationship can be deduced until more slides have been examined.

Granites

The most widespread granitic rocks in the area are foliated granites and gneisses - the strike of which is parallel to that of the adjacent volcanics. Sharp contacts between the granitic rocks and the volcanics do not occur and in some areas it is possible to trace the bedding of the volcanics through rocks mapped as "hybrids" by Williams (1) (which appear to be contaminated granites) into the gneisses. This relationship was also observed in the gneisses of the Kuribrong River,

An intrusive phase of microcline microgranite occurring as dykes, and related to the Kaburi Granite, is found discordant to the gneisses in various localities in the Mazaruni.

(1) D.R. Grantham, S. Bracewell, and G.J. Williams. 1934 Reports. Geol. Surv. B.G., Bull. 2, 1944.

A large band of biotite-granite extends in an E-W direction from Apanachi and has apparently developed intrusive (and partly faulted) relations with the surrounding volcanics. The composition of this granite is similar to that of the larger mass west of the Issano River.

Younger Basic Intrusives

Occasionally dykes and sills of fresh dolerite and gabbro are found cutting the Mazaruni Group and the granites and they are tentatively placed in the Younger Basic Intrusives.

White Sand Formation

This formation masks a large proportion of the solid geology and is composed largely of well-sorted, white, unconsolidated sands. In this area the white sands appear to overlie a variable thickness of brown sands which occur either as fine-grained fawn sands or as coarse, pebbly lignitic sands. The base of the series seems to be a band of coarse quartz gravel which locally may be replaced by a hard band of white quartzite.

Laterite

Occurs as the capping of the hills and is of two distinct types, the "honeycomb" variety and a fine-grained variety, the latter apparently closely associated with the older rocks.

E. SUPENAAM RIVER-GROETE CREEK AREA
By J. W. Lloyd, Geologist

The reconnaissance geology of the northern half of the Blue Mountains quarter-degree square 0658 was completed in two expeditions in March-May and in September.

Situated on the lower left bank of the Essequibo River, the area is drained to the east by a series of creeks of which the Supenaam in the north and Groete Creek in the south, are the largest. The physiography is diverse but can usually be related to the geology. The central portion is dominated by a high plateau of the White Sand Formation the edges of which are deeply dissected especially approaching metamorphic areas. Bordering the Essequibo is an extensive tract of low alluvial swamp which extends up most of the tributary creeks, for considerable distances in some cases. The granitic areas are usually undulating and can easily be distinguished from the serrated, laterite strewn ridges of the Barama Group.

GEOLOGY

5.	Superficial Deposits	Recent Alluvium White Sand Formation Laterites
4.	Younger Basic Intrusives	
3.	Granites	
2.	Metamorphosed Basic Intrusives	
1.	Barama Group.	

1. Barama Group

The group is found chiefly in the north-west bordering the Pomeroon and in the Groete Creek-Black Creek area. In the north-west there occurs a series of heavily weathered hornblende, kyanite, and manganiferous schists associated with garnet-mica metaquartzites, which appear to have resulted from the metamorphism of a predominantly arenaceous sedimentary facies, incorporating a considerable amount of basic tuffaceous material. The grade of metamorphism is generally low to medium, although the presence of kyanite and staurolite indicates localised areas of higher grade.

In the second area it is possible to distinguish a sedimentary sub-group composed chiefly of metamorphosed basic tuffs and quartzites, situated in Black Creek, from a basic igneous sub-group of metamorphosed lavas and possibly minor intrusions in Groete Creek. The latter are now represented by blocky epidote, hornblende schistose rocks several of which still retain such relict igneous characteristics as amygdales.

2. Metamorphosed Basic Intrusives

These rocks are represented in the northwest by the meta-gabbro complex of Supenaam Hill and by occasional medium-grained amphibolites. They occur as dykes or sills concordant with the strike at the adjacent sediments and were probably metamorphosed with them.

3. Granites

Acid rocks cover the largest part of the area and show a great diversity of mineral composition due to contamination by the Barama Group. Contact zones occur to the west of Karani Creek (north bank Supenaam) where foliated granites can be traced across the strike into banded hornblende-epidote-biotite gneisses, containing basic lenses, and finally hornblende schists, suggestive of granitic injection along a pre-existing structure. In the north muscovite granites predominate, occasionally developing contorted gneissic facies with incorporations of basic material as in Black Creek (Supenaam). Occasional euhedral epidote-mica granites and biotite granites occur.

In Groete Creek the type rock is a homogeneous biotite granodiorite which appears to cut across the strike of the Barama rocks and only shows foliation and slight contamination at the contacts. This rock is different to the Bartica Assemblage granites which may be related to those in Supenaam; it appears to be a higher crustal intrusive and may possibly be younger, for like the Younger Granites it is closely associated with gold.

4. Younger Basic Intrusives

Several medium-grained ophitic dolerite dykes with a general NNE-SSW trend occur south of Chalk Hill intruded into the granite.

5. Superficial Deposits

The typically unconsolidated White Sand Formation is extensively developed overlying brown sands, grits and clays, which appear to be residual wash-off deposits, residual bauxitic clays and laterites.

F. THE LOWER CUYUNI RIVER
By J.W. Lloyd, Geologist.

During the second field season (September-October) of 1958, two small areas in the lower Cuyuni River were mapped to conclude the reconnaissance geology of the Blue Mountains. The first of these was the Ecribisi Creek-Oko Creek area where an attempt was made to decide whether the alignment of these creeks was due to faulting or a granitization front. The second area was that adjoining the Mariwa and Tupuru Creeks.

In the Ecribisi the physiography can be divided into the central, mora-bush alluvial swamps bordering the meandering creek, the highly dissected slopesof Pulanbedamned Mountain, the highest point in the Blue Mountains, and the gently undulating granite hills to the east. In the second area a plateau of White Sand 400 feet above sea level dominates the northern border whilst a north-south 620 feet high laterite ridge separates the catchment areas of the two main creeks.

GEOLOGY

3.	Superficial Deposits	Recent alluvium White Sand Formation Laterites
2.	Granites	
1.	Barama Group	

1. Barama Group

The rocks of the Barama Group are exposed extensively in the rivers. They are chiefly medium to fine-grained, greenish-black schistose rocks composed of epidote, chlorite and hornblende which display blocky and sometimes spheroidal appearances on weathering. Unusual garnetiferous hornblende 'augen' schists occur west of Tupuru Creek. The weathering habit of the group coupled with the general lack of sedimentary characteristics suggest that they were originally basic igneous extrusives or minor intrusives.

Signs of acid intercalation are seen in rare biotite-sericite metaquartzites, some of which exhibit an irregular veined appearance due to their injection probably in the form of aplites prior to metamorphism.

2. Granites

Throughout the area extensive granitic invasion of the Barama Group has resulted in the formation of various hybrid gneisses exhibiting gneissose banding along the contacts which is concordant with the adjacent

rocks. Incorporation of the metamorphic rocks is considerable in these areas, where concordant lenses have been altered to produce, in general, light green biotite-epidote-hornblende rocks. Only to the west of Tupuru does there occur a homogeneous granite which is a medium-grained biotite variety and may be the mobilized element for this area.

The Barama Group-Granite association of these areas allows the latter to be included in the Bartica Assemblage.

3. Superficial Deposits

The White Sand Formation is extensively developed in the Tupuru area where it is predominantly unconsolidated white sand overlying brown sand and occasionally massive and laminated clays in which occur fossil leaves and lignite beds.

STRUCTURE

In accordance with the structure of the Blue Mountains the high dips of the metamorphics and small scale structures suggest steep isoclinal folding throughout the region.

Numerous changes in strike of the rocks outcropping in the Ecribisi Creek and in the neighbouring portions of the Cuyuni River point to much fracturing and faulting. No appreciable displacements appear to have taken place since the consolidation of the granite, and it is believed that the course of the Cuyuni, and the straight NE-SW courses of the Ecribisi and Oko Creeks, are due to zones of shear and fracture rather than to faults.

G. AREA NORTH-WEST OF QUARTZSTONE LANDING, CUYUNI RIVER.

By J.W. Lloyd, Geologist

During November the Cuyuni River between Quartzstone Islands and Kutuau Creek mouth was surveyed together with an area of 140 square miles on the east of Ukuau Creek.

Immediately inland from the swamps and gravel terraces bordering the Cuyuni the topography takes the form of a series of NE-SW trending ridges reaching to 500 or 600 feet and capped by a thick overburden of variegated clays, laterites and quartz sands. The predominant physical feature is the Supenaam Hill in the south-east, over 800 feet high, which forms a watershed between the Cuyuni and Wiribisiri drainage entering Pomeroon to the north. The northern drainage is dominated by the Pomeroon which flows through low, undulating clay hills, markedly different from the dissected terrain of the central and south-eastern areas.

GEOLOGY

5. Superficial Deposits
4. Granites
3. Basic Intrusives
2. Volcanic Group
1. Barama Group

1. Barama Group

The group has been divided into phyllite and tuff formations in the north bordering the Pomeroon and phyllite and quartzite formations with some gondites in the central area. The northern formations are predominantly soft red phyllites with interbedded diorite-epidote-hornblende schists, usually grey and green in colour, containing a high percentage of quartz and suggesting the low-grade metamorphism of intermediate to basic tuffs. It is probable that the phyllites contain pyroclastic material but are too weathered to allow positive identification.

The formations in the central area also consist predominantly of phyllites but are purple, silver-green and white in colour; the purple varieties often being associated with purplish-black manganiferous phyllites. Extremely fine-grained blue, pink and cream quartzites are commonly interbedded with the phyllites, forming resistant ridges. Where manganese is present the quartzites either contain lenses of "waddy" manganiferous material, or a manganese garnet and are thus termed gondites. Where heavily weathered, manganese laterites occur associated with granular gondites which are enriched in manganese oxide.

The relationship between different rock types is inconsistent, due possibly to lateral changes in sedimentation, while the discontinuity of the quartzites suggests structural squeezing out.

2. Volcanic Group

A group of volcanic rocks is well represented in the main river and immediately north-west of Supenaam Hill. It consists of interbedded tuffs, conglomerates and lavas of andesitic composition. Massive tuffs predominate, incorporating beds of conglomeratic andesite and quartz pebbles up to one foot in length at Pap Island. The elongate shape of some of the pebbles suggests derivation from rocks sheared previous to metamorphism. The group appears to show hardly any effects of metamorphism although chlorite is developed along shear planes in schistose rocks close to fault zones i.e. Ukuau mouth. The writer suggests that these colcanic rocks may represent synclines of the Mazaruni Group infolded in the phyllites of the Barama Group. The low grade of metamorphism of the volcanics is believed to point to a younger age.

3. Granites

The Quartzstone Islands are composed almost entirely of a homogeneous, foliated hornblende-epidote granite. At the contacts there is no sign of contamination while the foliation is discordant with the lineation in the neighbouring rocks. It would appear therefore that the granite is a high level intrusive or possibly faulted against rocks of the "Volcanic Group". Just south of Pomeroon a small intrusion of biotite granite occurs, concordant with the strike of the country rock.

4. Basic Intrusives

These constitute the blue-green, medium-grained amphibolites of Supenaam Hill and neighbouring ridges. Their strike directions conform with that of the "Volcanic Group" in an area where the group shows signs of shearing. At one locality at the foot of Supenaam Hill the amphilite was found to be sheared but the significance of such metamorphosed intrusives in a comparatively unmetamorphosed group is difficult to assess.

STRUCTURE

The structure of the area is believed to consist of a series of isoclinal folds with the axial planes dipping to the south - suggesting a position in the southern limb of an east-west trending antiform which has its acis situated to the north of Pomeroon head. As can be seen at Kutuau mouth the Barama and younger volcanic rocks have been folded together but their relationship lies in the fact that the former are metamorphosed and situated towards the centre of the regional structure while the latter are unmetamorphosed and situated towards the edge of the structure suggesting therefore that the volcanics are younger than the Barama.

H. GEOLOGY OF THE COUNTRY AROUND THE LOWER BARAMA AND MIDDLE WAINI RIVERS, AUGUST-NOVEMBER, 1958, by K. Bramley, Geologist

A reconnaissance survey was carried out in the middle Waini River and lower Barama River areas of the North West District during August-November, 1958. The object was to complete (on a scale of 1:125,000) a geological map linking together the two adjacent areas previously mapped by Bryn Davies, i.e. those areas to the south in the upper Waini country and the Middle Barama country.

The field work was carried out with the aid of a provisional geological map produced from the study of air photographs. River traverses were carried out on the Waini River as far as Maka Falls (62 miles above Barama mouth) and on the Barama River as far as Kumakandi, thus making acquaintance with rock types described by Bryn Davies. The geological conditions of the area were found to be generally similar to those described previously in adjacent areas and the main rock types are as follows:-

5. Superficial Deposits — Swamps and white sand
   Dolerites
4. Younger Basic Intrusives
3. Dolerites
2. Biotite and Biotite-Muscovite Granites
1. Phyllites, tuffaceous phyllites, tuffs and quartzites.

The meta-volcanics and meta-sediments forming the base of the stratigraphical table within the area were once classified as part of Conolly's "Volcanic Series"

but are now placed within the Darama Group. The two main types were often seen in rapid alternation (e.g. Tassawini Line). Low grade regional metamorphism has affected all these rocks and in certain areas higher grades of metamorphism have acted giving, for example, the staurolite schist on the Darama River at St. Bede's.

The structural trend of the country occupied by the Darama Group is essentially NE-SW; local small variations from the regional trend may occur. The schistosity and cleavage of individual units were seen to be concordant with the regional strike. Tight folding of the formation has occurred. It is probable that the localised zones of intense shearing occurred at the same time as the folding movements. After folding came the intrusion of the granites (to the far west the hornblende granites and to the east and south the biotite and biotite-muscovite granites). Small stocks of the latter were found within the folded Darama group. The age relationships between the two granites other than that they are both later than the Darama group is uncertain. The metasediments were all very weathered; even mine exposures fail to yield any fresh material.

Associated with the quartzite lenses seen in the west of the area (Ite Creek-Tassawini district) are the richly manganiferous rocks, but manganiferous phyllites occur over a wide area. These manganiferous rocks are a garnet-manganese-quartz association and are termed gondites. Usually the garnet (spessartite) is extremely weathered giving the rock a dull grey colour and appearing under the microscope as an opaque manganese oxide. This particular area containing the manganiferous lenses had already been mapped by Bryn Davies and later examined by a geologist of the African Manganese Company, Limited.

The biotite and biotite-muscovite granites are known to occur from a little north of Daramanni to the south of the area mapped where the granite continues into the upper Waini. North of Kwabanna the granite is found mostly to the east of Waini river, further south it spreads to the west of the river also. The granite is variable in composition and structure e.g. (a) the development of a foliation produced by mica alignment, greatest near Waka Falls and non-existent in certain other areas; (b) the localised development of orthoclase phenocrysts in the granite which is normally non-porphyritic.

The granite is traversed by pegmatites and coarse quartz veins. These quartz veins occasionally show shearing. The composition of the pegmatites is similar to that of the granite itself e.g. feldspars, quartz and micas. The pegmatites are best developed around Waka Falls.

Foliation directions in the granite were noted wherever reliable. The directions taken seemed too variable for any useful conclusions to be made; they are not brought out on the aerial photographs though the latter go far in showing the original jointing pattern of the granite.

Mica schists and quartz-mica schists occur a little below Waka Falls, these are steeply dipping and penetrated by unfoliated granite and pegmatites.

Dolerites were found over various areas surveyed. A larger dolerite intrusion occurs in the southeast of the area running in a high ridge roughly north-south. The intrusion is probably contemporaneous with the two dolerite intrusions to the north (i.e. running parallel to the Waini between the Morebo and the Barama) and the dolerites occurring in the upper Waini. Minor dolerite veins were noted in association with all the main intrusions. Local patches of white sands occur north of St. Bede's. Alluvial swamps merging into the coastal swamps mask a great deal of the solid geology.

I. KURUWA-KONAWARUK AREA

By M.W. Carter, Assistant Geologist

INTRODUCTION

This survey covers field work carried out between February and May, 1958, and was an extension of the work previously undertaken in the Kuruwa-Siparuni survey of 1957. A preliminary study of an occurrence of potarite in the Ireng Creek basin was also carried out. An area of seventy square miles including river traverses was mapped at a scale of 1/100,000.

PHYSIOGRAPHY

The Kwasinki-Kumuti (or Takwiari) Mountains form the main mountains of the area and lie between the Kuruwa and Konawaruk Rivers along the left bank of the Essequibo. The mountains rise to sixteen hundred feet in Kumuti (or Takwiari) Mountain and an impressive landmark - Kumuti Rock - is located on this mountain. A gently sloping lateritic surface was encountered at the summit of this range but it is considered as related to the regional northwesterly dip of the gabbro and not due to planation.

A planation surface at 1000 feet however occurs in the Kumuti Mountains as a lateritic bench.

GEOLOGY

Succession

s/

5. Superficial Deposits: White Sands and laterite.
4. Younger Basic Intrusives: Noritic-gabbro and dolerites.
3. Roraima: Conglomerates, sandstones, jaspers and cherts.
2. Younger Granites: Hornblende-granites.
1. Mazaruni Group: Conglomerates, sandstones, jaspers, greywackes, tuffs, cherts and rhyolites.

1. Mazaruni Group

A traverse of the Essequibo River from Kwasinki Fall (about fifteen miles above the mouth of the Konawaruk

River) to Siparuni mouth revealed a series of sandstones, quartzites, conglomerates and jaspers - part of which were termed the 'Muruwa Beds', during the Siparuni-Muruwa survey of 1957 - and which are clearly folded, with dips ranging from 15° to 45°. Just above Itanimi Fall the dip was north-westerly but changed through westerly to a general south-south-westerly dip at Muruwa mouth. In the previous survey (Siparuni-Muruwa 1957) a series of interbedded sandstones, conglomerates, and rhyolitic tuffs were observed in the Muruwa River between Pineapple Falls and Muruwa Mouth and it was then said that the relationship of these to the 'Muruwa Beds' (i.e. rocks at Muruwa mouth) was not clear. The present survey shows these rocks are of the same series and are all now united in the Mazaruni Group. Similar conglomerates and sandstones containing subangular pebbles of jasper occur about twenty miles to the west-south-west of Muruwa mouth at the head of Maam Creek (a right bank tributary of the Tipuru River) and also in the Ireng Creek about three miles above its confluence with the Siparuni River. In all these exposures conglomerate-sandstone rocks are associated with the distinctive volcanic facies of the Mazaruni Group.

2. Younger Granites

Medium-grained non-foliated hornblende-granite and granophyres occur at Twasinki and Itanime Falls, Essequibo River, and study of the contact zone of the granite with the sandstones shows that the granite was intrusive through the latter, establishing the granite as younger. At Itanime Fall peripheral plagioclase-amphibolite was found occurring between the granite and the Younger Basic Intrusives. The field relations of the granite, the plagioclase-amphibolite and the Younger Basic Intrusives seemed to indicate that the plagioclase-amphibolite was merely a marginal facies of the younger noritic-gabbros which might have been induced by contamination or stress during the cooling of the latter.

3. Roraima

Rocks belonging to this formation occur in the scarp at Takwiari (or Kumuti) Mountains, and comprise sub-horizontal bedded sandstone, conglomerate and quartzite. No jasper horizons were observed. The base of the formation was not seen and the relationship to the underlying rocks was not directly observable.

4. Younger Basic Intrusives

These are represented by plutonic and dyke rocks, the former occurring as thick sub-horizontal sills. They are mainly hypersthene-gabbros containing interstitial micropegmatite. The dyke rocks are fresh dolerites cutting both the Mazaruni Group and the Younger Granites.

5. Superficial Deposits

White and pink sands were observed in areas of outcropping sandstone, granite and volcanic rocks and are regarded as residual.

Lateritic deposits of the duricrust type were found in the Twasinki-Kumuti (or Takwiari) mountains. M
M In Kumuti (or Takwiari) mountain the laterite is about five feet thick, and is clearly derived from the hypersthene-gabbro.

ECONOMIC GEOLOGY

Gold

Gold colours were obtained from pits in Sand Creek, Muruwa River. During the preliminary prospecting for potarite small quantities of nugget gold were recovered from Stone Creek in the Ireng Creek Basin.

Silver

Associated with the gold recovered from Stone Creek in the Ireng Creek basin silver was found contaminating the gold.

Diamonds

No diamonds were recovered.

Potarite

A reported occurrence of this mineral by a prospector in the Ireng Creek basin was made to the Geological Survey Department. During a preliminary examination by pitting and panning the mineral was found to occur in the stream gravels in granite country. The potarite was found along with the gold and only small quantities of the mineral were obtained. The mineral is only just harder than gold and the specimens recovered being unworn it was considered that the mineral had not travelled very far. The creek from which the mineral was recovered - Stone Creek - traverses granite bedrock but rises in country in which gabbro forms steep-sided, heavily lateritised hills.

The gabbro itself is distinctive by virtue of its high felspathic content and the alteration of the ferro-magnesian constituents, and these factors combine to give the rock a light green colour distinctive of the rock type and rendering it a mappable unit. No ultra-basic horizons were observed and further work on the gabbro would be required to determine the mode of occurrence of the mineral, especially in view of the fact that the rock is deeply lateritised. Origin in the gabbro is considered by the writer as the most likely proposition.

About one mile northwest of the area studied, an exposure of hornblende-schist occurs in which occur clots of gabbro-pegmatite containing pyrrhotite. It was thought that this may have some bearing on the genesis of the potarite, but tests on the pyrrhotite showed that both palladium and nickel were absent. The granite bedrock was not observed in situ but a dark ~~slightly~~ weakly foliated granitic rock was observed along the stream course, and resembled granite found outcropping further away.

Owing to the small quantity of the mineral recovered it appears best to consider the working of the mineral as a by-product in the production of gold. In the area studied no special geological conditions were observed and in view of the large outcrops of gabbro and the similar geological conditions over the region it is probable that the mineral may be more widespread than appears to be the case.

J. THE ANNAI-KURUPUKARI SURVEY

By M.W. Carter, Assistant Geologist

This report relates to the field work undertaken during the period August-November, 1958, and covers an area of 250 square miles. The country studied included the watershed between the Rupununi and Burro-burro Rivers, to the west of the Annai-Surama section of the Cattle Trail, and the country lying to the east of this as far as the foothills of Mount Makarapan. A geological and topographical map was prepared on a scale 1/100,000.

The Annai airstrip was used for bringing up supplies and mail and owing to the late rains the Cattle Trail was only suitable for transport by bullock-cart towards the end of the survey.

PHYSIOGRAPHY

The area north of Annai is well-dissected mountainous country with the Annai Mountains occurring immediately to the north of Annai Village. The main river of this area is the Taramu which follows a general east-west course before it turns northeastwards in the neighbourhood of Surama Village to join the Surama river. To the east of the Annai-Surama section of the Cattle Trail mountainous country is also encountered, the main river being the Surama which flows north-westerly in its upper reaches and then turns northerly to join the Burro-burro.

The well developed east-west structural trend clearly observable in the Mazaruni Group dominates the topography, the mountains being elongated in a general east-west direction. This is clearly shown in the field by the small mountains. The mountain ridges are for the most part steep and narrow. It is possible that the general east-west direction followed by the Burro-burro and Rupununi rivers is related to this structural trend.

GEOLOGY

Succession

3. Dolerite dykes:	Fresh dolerite
2. Younger Granites:	Hornblende and hornblende-biotite-granite.
1. Mazaruni Group:	Rhyolites and tuffs.

1. Mazaruni Group

These, the oldest rocks in the area, cover a large part of the area mapped and are mainly rhyolites and altered sediments: dark-red, grey, or very dark grey in colour. Structurally they are well foliated, jointed, or steeply dipping with the dips of foliation vertical or nearly so. The trend of the foliation or strike of the dip is generally east-west and maintains this direction up to the granite contacts. The rocks are intruded by dykes of felspar-porphyry, micro-granite, micaceous aplite and dolerite. It was not possible to determine the trends of the dykes in most cases but the dyke of microgranite was found to follow the general grain of the country. One dolerite dyke followed a NE-SW trend.

The subordinate status of sediments associated with these rocks was in marked contrast to the rocks of the Mazaruni Group in the Siparuni-Muruwa and Muruwa-Konawaruk areas previously studied. Although the rocks in the Siparuni area show some shearing (e.g. at S-Falls where the rocks are well foliated along east-west lines with a steep dip to the south) structural deformation is not nearly so marked as in the Annai area.

In many localities boulders of vein quartz up to ten inches across were found associated with these rocks but definite quartz veins were not encountered, though these may occur in depth. The vein-quartz boulders were not in any way mineralised.

2. Younger Granites

These rocks, together with the Mazaruni Group, comprise the main formations of the area. The granite is a pink hornblende-granite which, in places, becomes very coarse approaching a pegmatitic facies. The granite is in many cases porphyritic and granite-porphyry is common, occurring especially near the contact with the Mazaruni Group. The granite has been seen in one place to be layered: a lowermost layer of massive granite giving way upwards to granite-porphyry and this to rhyolitic rocks; the uppermost layer showing a return to granite-porphyry. It does appear that some of the granite may be sheet-like in form, and this facies layering may help to explain the occurrence of rhyolitic rocks unrelated to the Mazaruni Group outcrops.

The granite is cut by granophyre and rhyolite dykes the trend of the latter being ENE-WSW. Aplite dykes and quartz veins were seen transecting the granite mass close to the foot of the north-western flank of Mount Makarapan, but no mineralisation was observed - pitting in the creek yielded no gold, but small quantities of buff-coloured muscovite-mica were recovered.

Some degree of foliation occurs in the granite in places, but this is not generally the case. The rock is essentially non-foliated and contains clots of hornblende material.

3. Dolerite dykes

Dolerite dykes cutting both the Mazaruni Group and the Younger Granites occur. The general direction of the dykes was not ascertained, but one dyke in the Mazaruni Group followed a NE-SW trend, and one in the Younger Granite, NW-SE. The dolerite in both cases is fresh and very similar in hand specimen.

ECONOMIC GEOLOGY

Gold

Systematic prospecting over the area yielded very disappointing results especially in view of the large areas covered by granite. Gold colours were found at one place only near Mile 175 on the Takama-Annai Cattle Trail, in country underlain by the Mazaruni Group.

Mica

A little buff muscovite-mica was obtained from a creek flowing over an aplite dyke at the foot of the north-western flank of Mount Makarapan.

Radio-active Minerals

No radioactive minerals or beryl were discovered in the area.

K. ORIGIN OF THE COLUMBITE OF ROBELLO CREEK, MORABISI RIVER, by M.G. Allderidge, Assistant Geologist.

During the February-May field season a survey was conducted in the area to the south of Robello creek in the Morabisi Basin, where alluvial columbite was formerly mined, to try and locate pegmatites containing columbite, and to see whether other minerals of economic importance were associated with them.

Robello creek flows east across a basin eroded in granite, which has a dolerite intrusion as its lip. The creek and its tributaries rise on the dolerite round this basin, and along with the Morabisi river, break through the ridge in the east. The granite is a light grey microcline-biotite variety with occasional muscovite, and is of uniform composition, unfoliated and without xenoliths. It belongs to the Younger Granite suite and is assumed to be a batholitic intrusion. The exact nature of the dolerite mass cannot be determined without further mapping in the north.

Pegmatites and subordinate aplites are common but were disappointing mineralogically. The pegmatites are intruded as dykes with sharply defined margins, and vary in width from one inch to 8 feet. They were almost certainly emplaced into a solidified granite and are not replacive. Complex structure and mineralogy are unknown, very simple zoning round a quartz core being occasionally observed. The major

constituents are oligoclase quartz and muscovite, garnet being the only accessory. Some very minute crystals of columbite were discovered and a small patch of green beryl, but only in one area, while epidote, magnetite, ilmenite and haematite (after magnetite) are of regular though not frequent occurrence; torbernite and gahnite were recorded only once. It is significant that no coarse columbite was found in any of the many pegmatites of the area. The aplites, which are less common than pegmatites and occur as veins or cores in the latter, are of a simple quartz-felspar-muscovite composition with accessory garnets.

Detailed pitting and prospecting was carried out in eluvial and alluvial material in an attempt to trace the columbite to its sourse. It was hoped that by systematic pitting in eluvial material, pegmatites containing columbite might be revealed by surface anomalies. This proved impossible due to the extreme thickness of decomposition, and local anomalies caused by irregular surface enrichment. Attention was then turned to the alluvials and it was found that coarse columbite and its associates occur up to the heads of the creeks. None of this coarse material could be discovered in the residual material around these creek heads. The only times that columbite of such a grade was obtained away from a creek was in a small alluvial deposit on a hillside.

It is considered that the columbite in the basin may have come from pegmatites at a higher level in the granite which have now been eroded away. The area is one of mature drainage and there is evidence of terraces having occurred over much of the area although most have now been removed. The columbite has therefore probably been through two or more cycles of deposition. It is usual to find the rarer minerals in roof pegmatites and although these may not have been particularly rich in columbite the effect of the dolerite could cause great concentrations of heavy minerals in the bottom of the basin thus giving the impression of a rich source.

There is also a possibility that some of the fine grade material may be from the granite itself, but this is insignificant compared with the source of the coarse material.

L. PRELIMINARY REPORT ON A VISIT TO THE MAHDIA GOLDFIELD, POTARO DISTRICT, by L.L.Fernandes, Assistant Geologist.

INTRODUCTION

The area was visited from 22nd February to 23rd May with the object of investigating the gold occurrences in the lateritic mantle on the hills near Mahdia and assessing their economic potentialities. Although the Potaro District has yielded several hundred thousand ounces of gold most of this has come from small scale alluvial workings and by dredging the Mahdia and Minnehaha Rivers, and very little has been won from lode mining or the detrital deposits on the hill slopes. Should there be a large enough cubic yardage of material on these hills

with gold value above 5 grains per cubic yard, it may be possible to hydraulic this material profitably and extract the gold.

In the course of investigations, the Potaro-Mahdia river channel, described by G.J. Williams in 1936 (1) was identified, and an attempt was made to determine whether the infilled material carried enough gold to merit extraction at a profit.

METHOD OF INVESTIGATION

Reconnaissance prospecting showed that the hills on the left bank of the Mahdia River were poor in gold, so detailed investigations were confined to the right bank. Gold values were found to decrease with depth from the surface so routine testing was carried out in the top 3 feet of the surface mantle. Shallow pits were dug at 200 feet intervals along bush lines and 1 or 1½ buckets of material washed from each pit.

A number of pits and cuttings in the Proto-Mahdia channel were examined, 1 bucket of material being washed from every foot of depth.

NATURE OF MATERIAL TREATED

The majority of the hills prospected are covered by smooth, rounded lateritic pisolites or pebbles, with diameters of ¼" to 1". The top 1 foot is almost free from clay, the proportion of which increases with depth, and pebbles are usually absent below 5 feet. There is a striking absence of water-worn quartz or other material associated with the laterite. Owing to the round nature of the ironstone pisolites these deposits had previously been regarded as "lateritised outwash fans" (G.J. Williams, 1936 op.cit.) but are now recognized as a normal lateritic ironstone composed of concretionary pisolites forming at the expense of weathered bedrock. There has been a residual concentration of laterite and the heavy minerals, gold, ilmenite, magnetite and haematite on the surfaces, while the less stable associated minerals were leached.

The Proto-Mahdia was a pre-White Sand river which is now infilled with highly altered boulders of sandstone and other material difficult to identify in the altered state. The river clearly played a part in the deposition of the White Sand Formation. The material infilling the channel becomes progressively more sorted, altered and waterworn as the course is traced downstream, grading into a wide expanse of white sands and clays.

RESULTS

The result of the investigation of the hill deposits in the area was somewhat disappointing. Values seldom exceeded 4 grains per cubic yard, and were mostly below 2 grains per cubic yard. The prospect of hydraulicking the surface mantle on the

(1) Williams, G.J., The geology and gold deposits of the Potaro. Geol. Surv. B.G., Bull. No.3, 1936.

hills is not very encouraging.

In all prospecting the Proto-Mahdia channel, gold values were obtained throughout the thickness of each pit or cutting. The values obtained ranged between 4 and 12 grains per cubic yard, and it does seem that further investigation is merited as there may be a sufficient volume of material to support an organized hill-sluicing scheme.

A TOUR OF THE MAZARUNI MINING DISTRICT
By L. L. Fernandes, Assistant Geologist

INTRODUCTION

Between August 13th and November 12th, the writer carried out a tour of the Mazaruni Mining District, visiting most of the diamond and gold workings between Puruni River mouth and Peaima Falls.

The object of this tour was to obtain first-hand information on the general state of mining, and on the activities of the porknockers in the district. In the course of the tour, advice on better methods for recovering minerals and better working grounds was given to the workers whenever possible.

BRIEF DESCRIPTIONS OF AREAS VISITED

It was not possible, in most cases, to stay longer than one week in each area. A brief report on the mining activity in each area follows:

(a) Lower Puruni River Area

There are three persons working in the Lower Puruni, two of whom are engaged in rewashing the tailings of the Old Peter's Mine. The easily accessible gold deposits have been worked out, but it may be possible to work some terrace deposits near Peter's Mine by hill sluicing.

(b) Semang River Area

One crew was working in this area. The men were making preparations to wash a portion of a sandy terrace about $\frac{3}{4}$ mile from the mouth of the Semang River. An 8-foot pit showed fine gold throughout its depth, while good diamond indications occur in gravel 1 foot thick, at the base of the pit. Both minerals would be extracted when operations are started.

(c) Karanang River Area

Most of the men in this area recover diamonds from the river bed by 'water dogging' - as diving in shallow water without using a helmet is called. This method has been highly successful in the falls area during the dry season, but it is dangerous and

often impossible in high water. It seems that most of the rich pools have been worked out. Three crews working on the land are having fair success.

(d) Meamu River Area

Three crews totalling 10 men were working in the Merume at the time of our visit. Both gold and diamonds are recovered here, and there seems to be sufficient payable ground there to keep them occupied for a few years.

(e) Oranapai Area

This area has been worked for diamonds for several decades, and the rich spots have long since been worked out. The population of about 50 men barely earn their bread by winning a few diamonds from rewashing old tailings and cleaning the edges around pre-existing pits. The future of this area is very dim.

(f) Enachu Area

The greatest concentration of men is in the Marabunta creek area where about 20 men work in the flats of these creeks. There is a fair amount of unworked land which should provide work for another 1 or 2 years. The majority of other porknockers in the area are working in claims that have been extensively worked in the past.

Three diving crews were operating in the Enachu-Tumereng stretch of river. This area was worked before with some success, but the divers were less fortunate this season.

(g) Eping-Perenong Area

The Arodina Creek area is still yielding diamonds to about 24 men working there. Pumpkin Creek, a tributary of Arodina has a fair amount of potentially payable unworked land which should support a small number of workers for a few years. The June Creek area and the Perenong-Upper Towaikuru Creek areas are near exhaustion. The Lower Towaikuru area does not seem to be as rich as were the upper reaches, but there is a fair amount of unworked land there, though somewhat deep.

(h) Kurupung River Area

The greatest concentration of men is at K_3 Landing, lower Kurupung River. About 60 men are working in the flats of the Cartoon and Cashboy Creeks. One claim on the Cartoon yielded several hundred carats early this year, and now that this is worked out more attention is being paid to the larger area of partly worked land in the neighbourhood

There are a few scattered workings in partly worked ground higher up the Kurupung, one in a terrace deposit at Rock Point Landing, where pits are over 20 feet deep.

At the time of our visit, there were two crews prospecting above Kumerau Falls in unworked land. A number of diving crews have since entered that area, and according to reports, their prospecting has been highly successful.

(i) Apaiqua-Meamu Area

There are about 40 men working from Apaiqua Landing, 10 of whom are employed by B.G. Diamond Mining Co. Ltd. in their diving operations above Apaiqua Falls. Other workings are scattered on the tributaries of the Meamu River and on Passover Creek. Production in this area is on the incline.

(j) West Kaburi River Area

There are about 10 men recovering gold from the flats of tributaries of the West Kaburi River near mile 13 on the Issano Road. This area has been extensively worked in the past as the yield of present working is on the whole poor. There are a number of narrow gold quartz stringers exposed in cuttings in the area, but none of those examined could be worked economically. There is room for further prospecting here.

CONCLUSIONS

Porknockers should be more careful in their methods of recovery of gold and diamonds. In several instances, gold occurs associated with diamonds in sufficient quantities to merit extraction.

The steady decline in diamond production by porknockers will continue unless new lands are prospected. The rich deposits discovered early in this century have nearly all been worked out, and can no longer support the population.

A P P E N D I X II

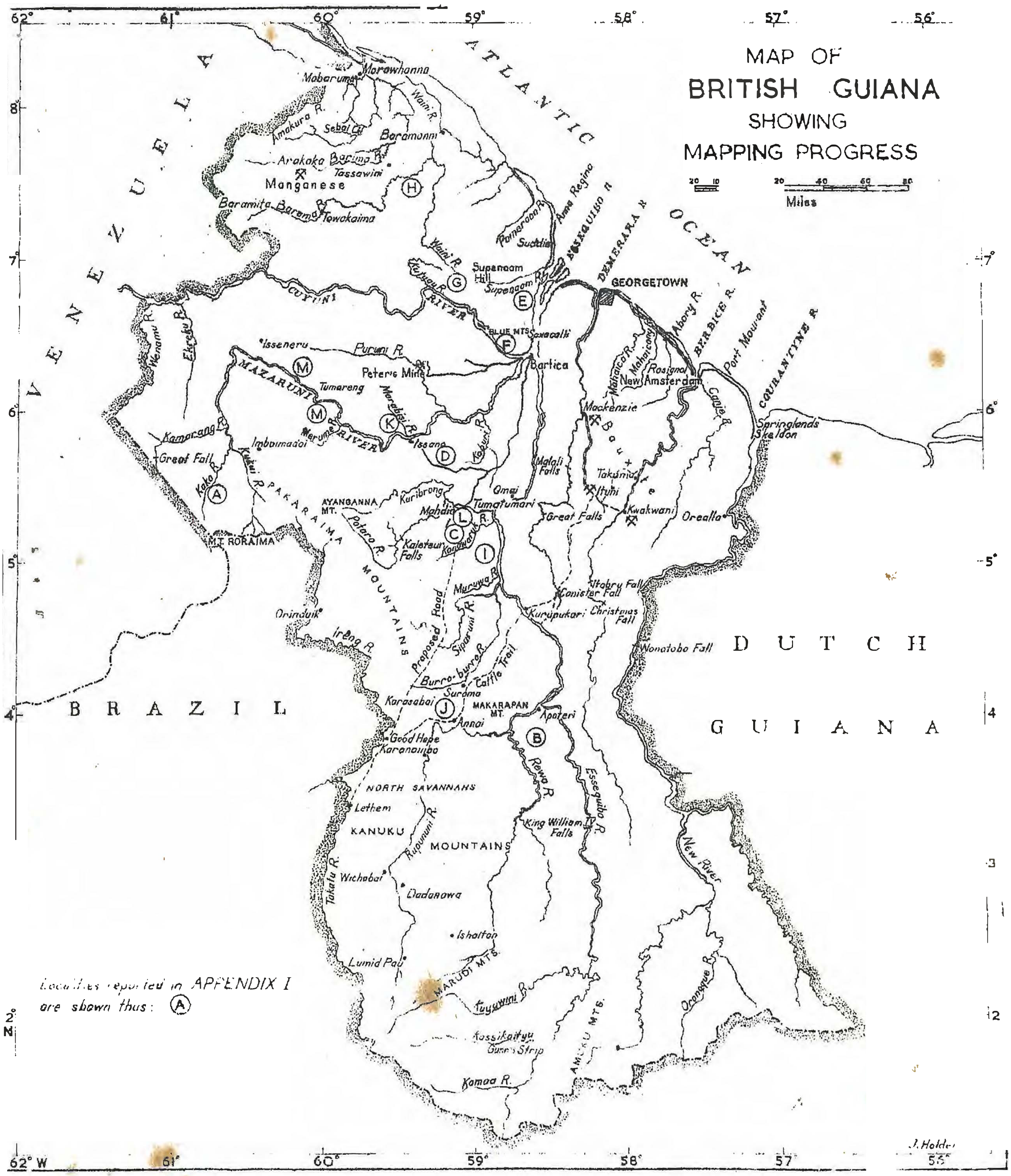
GEOLOGICAL SURVEY OF BRITISH GUIANA

SENIOR STAFF AT 31.12.58

Establishment

1 Director	R.B. McConnell, M.A., D.ès.Sc. (Lausanne), D.Phil., F.G.S., M.I.M.M.
1 Deputy Director	C.G. Dixon, B.Sc., F.G.S.
3 Senior Geologists	P.H.A. Martin-Kaye, B.Sc., A.R.C.S., F.G.S.* D. Bleackley, M.A., F.G.S. P.B.H. Bailey, M.A., F.G.S.
1 Chemist-Petrologist	J. Schilling, D. Phil. Nat.
6 Geologists	C.N. Barron, B.A., F.G.S. R.T. Cannon, B.Sc., F.G.S. P.I. Morris, B.Sc., F.G.S. J.H. Bateson, B.Sc. J.W. Lloyd, B.Sc. K. Bramley, B.Sc.
1 Geophysicist-Hydrologist	L.E. Ramsahoye, B.Sc., D.I.C., Ph.D. (London).
5 Assistant Geologists	M.W. Carter, B.Sc. M.G. Allderidge, B.A. L.L. Fernandes, B.Sc., A.R.S.M. R.C. Sansom, B.Sc. J.W. Carter, B.Sc., A.R.S.M.
Scientific Assistant	D.O. Pollard.
3 Field Observers	O. St. John W.H. Johnson A.O. Edwards
Drawing Office Supervisor	T.M. Rahaman, Graduate of Technical Institute, Trinidad.
2 Senior Drawing Office Assistants	Miss I.V. Lowe K. Lall.
1 Chief Clerk	F. Johnson
1 Class I Clerk	L.F. Choy
1 Secretary	Miss R.E. Harry
1 Supervisor of Library and Records	H.K. George

* On secondment to Windward Islands.


MAP OF
BRITISH GUIANA
SHOWING
MAPPING PROGRESS
Miles
ATLANTIC
OCEAN
VENEZUELA
BRAZIL
DUTCH
GUIANA
Morawhanna
Mabaruma
Amakura R.
Waini R.
Baramanni
Arakaka
Tassawini
Manganese
Baramita
Towakaima
Pomeroon R.
Suddie
Supenaam
Hill
ESSEQUIBO R.
DEMERARA R.
GEORGETOWN
Abary R.
BERBICE R.
Port Mourant
COURANTYNE R.
CUYUNI
RIVER
BLUE MTS.
Bartica
Isseneru
Puruni R.
Peters Mine
MAZARUNI
Tumareng
RIVER
Wenamu R.
Ekreku R.
Kamarang R.
Imbaimadai
Great Fall
Kako R.
Issano
Rosignol
New Amsterdam
Mackenzie
Bauxite
Malali Falls
Takama
Ituni
Kwakwani
Orealla
Springlands
Skeldon
AYANGANNA MT.
Kuribrong
Potaro R.
Mahdia
Tumatumari
Omai
Great Falls
PAKARAIMA
MT. RORAIMA
Kaieteur Falls
MOUNTAINS
Canister Fall
Itabru Fall
Christmas Fall
Kurupukari
Orinduik
Ireng R.
Proposed Road
Siparuni R.
Burro-burro R.
Cattle Trail
Surama
Wonatobo Fall
Karasabai
MAKARAPAN MT.
Apoteri
Annai
Good Hope
Karanambo
Rewa R.
NORTH SAVANNAHS
Lethem
KANUKU
MOUNTAINS
Rupununi R.
Essequibo R.
King William IV Falls
New River
Takutu R.
Wichabai
Dadanawa
Ishalton
Lumid Pau
MARUDI MTS.
Kuyuwini R.
Kassikaityu
Gunn's Strip
Kamoa R.
ACARAI MTS.
Oronoque R.
Localities reported in APPENDIX I
are shown thus: (A)
62° W
61°
60°
59°
58°
57°
J. Holder