



GUYANA

Ministry of Agriculture and Natural Resources

**REPORT ON THE GEOLOGICAL
SURVEY
THE YEAR 1965**

Geological Survey Department

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GEOLOGICAL SURVEY DEPARTMENT
Ministry of Forests, Lands and Mines

ANNUAL REPORT 1965

GEOLOGICAL SURVEY DEPARTMENT

ANNUAL REPORT FOR 1965

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I. Introduction

The conclusion of the 1962-1965 United Nations- British Guiana Aerial Geophysical programme at the end of 1965 renders it appropriate in this report to review not only the events of 1965 but also briefly to summarise the work carried out during the United Nations project and other technical background of the achievements. Some explanatory comment is needed in order that they appear in proper perspective.

Since 1962 the Geological Survey has been re-examining known gold areas with geochemical techniques. In brief, geochemical surveys consist of the systematic collection of surface samples and their careful analysis for trace amounts of significant elements. When the data are plotted, areas of higher than average metal content may be established, although the actual amounts analysed may still be very small. These areas are of interest in that they may reflect concealed mineralisation beneath. Further work can then be concentrated at these localities and additional techniques may be introduced. In the final stages, if results are sufficiently encouraging, pitting, trenching and eventually drilling may be undertaken. The known gold areas have been selected for the first attack since these are proven mineralised regions and are thus the most obvious targets for the new techniques.

Exploration by the Department has been given great stimulus and a further considerable quantity of additional guiding data by the recently concluded United Nations-British Guiana Aerial Geophysical Survey. Under the project, further detail of which is given elsewhere in this report (Section III), airborne geophysical surveys were flown over some of the most promising regions of the country and a substantial number of localities for ground follow-up operations had been indicated.

The techniques utilised were airborne magnetometry and electromagnetometry. In the first, characteristics of the Earth's natural magnetic field are measured. They commonly reflect variations in the rocks below. By the latter technique it is possible to ascertain the presence of electrically conductive zones, sometimes due to mineralisation, in the ground.

Airborne geophysical surveys thus provide a rapid means of preliminary review and reconnaissance of large areas and can, on occasion, lead directly to mineral deposits. Similar coverage on the ground would be an extremely tedious, very long drawn out, and hence highly costly process, and the results in certain respects not as satisfactory.

In the light of this new data and progress a substantial number of exploration targets have been scheduled for attention. The question presenting itself now for follow-up ground investigation is happily not so much where? as where first?

II. Review of the Year

a) Accommodation of the Ministry of Forests, Lands and Mines

In recognition of the rather special functions and scientific character of the Geological Survey Department, the general Governmental policy of the past few years of integration of Departments with relevant ministries has not

been pursued for the Geological Survey at the same pace as has been the case elsewhere. The new Government elected towards the end of 1964 created a new Ministry of Forests, Lands and Mines and responsibility for the Geological Survey was shifted from Ministry of Trade and Industry to this Ministry. The Ministry is accommodated in the Geological Survey Compound, the Ministerial offices occupying a building which was previously the Deputy Director's house and partly in the second of the three houses in the compound, previously allocated to the Geochemist. The Mines Division occupies the remainder of this house.

b) Integration of Geology and Mines

New Government policy also provided for the integration of the Geological Survey Department and the Mines Division. The latter section has become progressively weakened over more recent years and since there are certain limited areas of overlap, in the interests of the two Departments amalgamation was proposed.

The second house of the compound was allocated for accommodation for the Mines Division but later it was suggested that the main Geological Survey building should house both sections. Appropriate adjustments were made in the Geological Survey Museum and Clerical Office to receive the staff of the Mines Division but at the year end staff had not yet been transferred. It has become clear however that the Geological Survey cannot spare this space without impairing its efficiency. Moreover, it is in any event inadequate for the expansion of the Mines Division which must be pursued with the greatest energy.

The U.N. Adviser, Mr. G.A. Moorhead, one time Commissioner of Lands and Mines in British Guiana and recently Commissioner of Mines in Jamaica includes within his terms of reference the duty of drawing up a programme for the integration of the Geological Survey Department and the Mines Division.

In the middle of the year it was established from the United Nations that the Special Fund would be receptive to consideration of follow-up programme to the 1962-1965 Aerial Geophysical Project then approaching termination. In the absence of the Director a draft continuation project was submitted to New York. Dr. Martin-Kaye discussed the matter in New York en route back to British Guiana in December, and, on return to Georgetown, revised the application taking account of the suggestions and reservations expressed by the United Nations.

The revised project was submitted just before the New Year and has been well received. There are sound hopes that it will be accepted.

In the programme now put forward for British Guiana emphasis is placed upon a strong ground follow-up of the data provided by the preceding scheme. It envisages provision by the United Nations of expertise, some additional air-borne electromagnetic surveys, helicopter services and further drilling and other equipment. The Government would provide counterpart ground crews, laboratory facilities and other services. The total cost is estimated U.S. \$2,113,200 spread over three years of which the contribution from Guyana would be U.S. \$1,146,600 approximately.

The Geological Survey regards the implementation of this project as vital if ground investigation of the numerous targets now suggested for investigation is not to take an untenably long time.

c) Staffing

The already desperate staffing situation of the Department worsened during the course of the year. At the year end there were 11 posts awaiting appointments. The position was aggravated by the absence of two officers on post-graduate studies overseas, and the inevitable incidence of leave. During the second field season, despite the substantial establishment of the Department, numbers were so reduced that only three geologists could be sent into the field. The position was sustained by placing greater responsibility for certain field operations upon junior staff. To this challenge they responded nobly.

The staff shortage has been extremely hampering. Fortunately, there are now good prospects of a radical change that may bring the Department to full strength, or near it, during 1966.

Mr. R.H. Hewins completed his contract in February; Mr. F.J.L. Guardia and Mr. C.D.G. Black during March. Mr. E.R. Biggs was forced to ask for early release from his contract for personal reasons and also left the country in March. Mr. J.H. Bateson, Senior Geologist, who had been with the Geological Survey since 1957 obtained transfer to the Directorate of Overseas Geological Survey and took up the new appointment at the end of August. All these officers performed valuable work for the Department but the loss of Mr. Bateson who had gained considerable experience in British Guiana was particularly sorely felt.

Mr. J.D.N. Punwasee, Geologist joined the Department in early December, and Dr. H.O. Bruggmann arrived shortly before the end of the year. Their arrival was particularly welcome in view of the severe depletion of strength at that time. Subsequently Mr. F.J.L. Guardia has returned and a number of additional recruits are anticipated within the next few months.

An important factor in aiding recruitment is the increase of Overseas Service Aid Scheme allowances which raise salaries of overseas recruited personnel to an internationally competitive level. As yet the impact of this has still to be fully realised but there is no doubt that it has substantially enhanced recruitment capacity.

Mr. V.H. Campbell, Chief Clerk, was appointed Senior Personnel Officer of the Ministry of Forests, Lands and Mines with effect from 10th May 1965. Since that time Mr. S. Singh has been acting in the post of Chief Clerk.

Mr. O. St. John, Scientific Assistant, retired from the service on medical grounds during the year. He originally joined the Department in 1943 and has been associated with very many expeditions in the Interior.

Miss C.M. Johnson, Acting Secretary to the Director for several years was transferred to substantive appointment on 29th November 1965. A summary of availability of more senior staff members during the year is given in Appendix II.

d) International Aid Personnel

Mr. E. Wicherts, Project Manager of the United Nations-British Guiana Aerial Geophysical Survey left the country on the conclusion of his assignment on 7th November, 1965. Mr. Wicherts had been Project Manager since 24th March 1964.

The last of the airborne contract work of the U.N. Project was completed on 1st July, 1965 and the aircraft and contract personnel left the country soon afterwards.

Mr. J.R. MacDonald, Economic Geologist, appointed through the United Nations Technical Assistance Board continued work with the Department until his assignment concluded on 6th October 1965. He arrived on 27th September 1964. Mr. MacDonald's advice has been most stimulating. His final report which reviews all existing data in the light of his considerable experience will be of key importance in the guidance of future mineral exploration, both by the Department and Mining Companies. Arrangements have been put in hand for early publication of the report.

Mr. D.A. Miller, Driller, appointed under the United Nations Project, continued with the Department throughout the year. He originally arrived in the country on 25th September 1964. His services have been invaluable in ensuring the efficiency in the Department's drilling operations and in training drilling personnel. His assignment has been extended to carry on into 1966.

Early in the year the Department received a very welcome visit from Dr. W.D. Johnston, of the United States Geological Survey. As a result of this visit which was arranged by Mr. H. Yoe, head of the A.I.D. Mission in British Guiana, 12 man-months of specialist services were offered by the United States Government to the Geological Survey.

The first specialist under this very welcome assistance programme, Mr. W. Griffiths, field geochemist, arrived in Georgetown on 31st October. Other members of the team were due to arrive early in 1966. The Geological Survey of British Guiana very much hopes that it may receive further help from the United States Geological Survey with which it has long held most amicable relations.

Special mention must be made of the assistance accorded by the Directorate of Overseas Geological Surveys in London to the Department. During 1965 check of certain of the Geological Survey analytical results was carried out, and a series of gold assays undertaken for the Peter's Mine operations.

e) Training Tour

Mr. C.N. Barron, Senior Geologist, undertook a five week tour of Canadian Mining Districts during September and October under the auspices of the Canadian Department of External Affairs in collaboration with the Geological Survey of Canada and various mining companies.

f) Post Graduate Studies

Mr. M.W. Carter continued his studies for the M.Sc. degree in Geo-chemistry at Carleton University, Ottawa, under a Canadian Commonwealth Scholarship. He successfully presented his thesis at the end of December and is due to return to the country early in the New Year. The absence of a Geo-chemist has been severely felt and Mr. Carter's return will be particularly welcome.

Mr. M.A. Lee, also a Commonwealth Scholar, continued post graduate studies in Geophysics at Imperial College, London. Originally aimed at an M.Sc. degree, study leave has not been extended for a additional year to encompass a Ph.D. Mr. Lee is expected to return to the Department in 1966, and his additional training promises to be of great value to the Geological Survey's Mineral Exploration Programme.

g) Other Training

Miss R.E. Harry, Supervisor of Library and Records, took the opportunity of visiting some important geological libraries in the United States in August and September during her long leave. Included were the libraries of the United States Geological Survey in Washington and in Denver, Colorado. These visits which provided valuable ideas for the improvement of efficiency in the Geological Survey Library were arranged under the auspices of the United States A.I.D. Programme in collaboration with the United States Geological Survey.

Miss I.V. Lowe, Senior Assistant Draughtsman, returned from long leave in March. During her absence Miss Lowe undertook a five months study course in geological cartographic techniques in United States Geological Survey drawing offices in Washington D.C. and Silver Springs., Md. These courses were also arranged under the auspices of the United States A.I.D. Programme. In addition Miss Lowe also apid a four day visit to the Directorate of Overseas Surveys at Tolworth in England.

Mr. M.D. Hope spent three months in the United Kingdom undergoing re-fresher training in the Laboratories of the Mineral Resources Division of the Directorate of Overseas Geological Surveys. Emphasis was placed on fire assaying but included other aspects of Geological laboratory work. The Department has been hampered by a bottle-neck in assaying and Mr. Hope's additional training will be an important factor in overcoming the problem.

h) Visits and Tours of Inspection

Shortage of Senior professional staff and pressure of Headquarters work in face of impending long leave of the Director prevented the number of visits to field operations that he would have wished.

Two excursions were undertaken both to the Peter's Mine operation. A measure of the pressure placed on the personnel of the Department may be gained from the fact that it was necessary for the Deputy Director to take direct command of the drilling operations at Aranka for a spell and for the Director himself to take over temporarily at Peter's Mine. During the first visit to Peter's Mine, Dr. Martin-Kaye accompanied Mr. J.R. MacDonald and had the pleasure of welcoming His Excellency the Governor, Sir Richard Luyt, who journeyed from Georgetown by helicopter. Accompanying Sir Richard and also very welcome was Colonel Hill of the Lancashire Fusiliers.

During his long leave Dr. P.H.A. Martin-Kaye visited the Directorate of Overseas Geological Surveys in London, and various organisations and mining companies in England and Europe. Included were the Geological and Geophysical Institute, Belgrade, and the Trepcia Mines in Yugoslavia, and the headquarters of the Geological Survey of Greece.

The Director returned to British Guiana via New York in order to confer with United Nations officials on the results of the United Nations Special Fund-British Guiana Aerial Geophysical Survey and the proposed follow-up programme. These projects are further discussed under sections II(b).

During Dr. Martin-Kaye's absence Mr. P.B.H. Bailey acted as head of the Department and Dr. S. Singh as deputy head of the Department.

i) IVth Caribbean Geological Conference

Dr. P.H.A. Martin-Kaye and Dr. S. Singh represented the Department at the IVth Caribbean Geological Conference which was held in Trinidad from 28th March to 4th April. The Department was responsible for the initiation of this sequence of conferences which is now recognised as one of the most important regional geological conferences in the world. About two hundred delegates attended the meetings in Trinidad and the Department was honoured by an invitation to Dr. Martin-Kaye to be the principal professional speaker at the opening session. Papers presented from British Guiana were as follows:

- i) Geochemical Drainage Reconnaissance Surveys over rocks of Barama-Mazaruni Assemblage in Cuyuni River Basin, British Guiana. G. Harden
- ii) The Occurrence of sillimanite and its status as an index of metamorphic grade in the Guyana Shield rocks of Southern British Guiana ... S. Singh
- iii) Recent Developments in the Diamond Mining Industry in British Guiana L.L. Fernandes
- iv) Minor Folding in the Manganese Deposits in Matthew's Ridge, Northwest District, British Guiana. L.L. Fernandes
- v) A study of Gold Mineralisation in Central British Guiana. J.W. Carter

Mr. L.L. Fernandes and Mr. J.W. Carter, members of the academic staff of the University of Guyana, were geologists with the Geological Survey when much of the work incorporated in their papers was undertaken.

j) Advice to Caribbean Territories

With the approval of the Government of British Guiana Dr. Martin-Kaye visited Barbados for three weeks in order to advise on geological aspects and the availability of raw materials for a proposed cement plant. In addition he undertook further observations on the geology of the Scotland District, the soil erosion problems of which have particularly strong geological basis. Dr. Martin-Kaye has advised the Government of Barbados several times in this connection and on this occasion assisted in the preparation of an application

to the United Nations Special Fund for help in establishing the techniques necessary to handle a new sector of the affected area.

Dr. Martin-Kaye also visited Montserrat for a few days en route to the United Kingdom in order to advise on ground water drilling programme.

III. 1962-1965 United Nations Special Fund-British Guiana Aerial Geophysical survey

The United Nations-British Guiana Aerial Geophysical Survey concluded at the end of the year. Mr. E. Wicherts, the Project Manager, left the country on November 4th.

A. The Project

In summary the operational history of the scheme was as follows:

The project was governed by a Plan of Operation dated June 14th 1962 and subsequent modifications. Flying of airborne magnetometer surveys commenced on October 11th 1962 and was completed on April 16th 1963. A total of 24,318 line miles were flown, covering approximately 16,000 square miles. Flying of airborne electromagnetic surveys commenced on 24th September 1964, finishing on 1st August 1965. In this second phase 16,733 line miles were flown, covering approximately 3850 square miles.

The total cost of the scheme (latest available information) was estimated at U.S. \$1,301,255 of which the U.N. Expenditure was \$608,255 and from Government U.S. \$693,000.

In addition to the airborne data and expert advice the Geological Survey benefitted very considerably by equipment made available by the United Nations under the scheme. This included U.S. \$64,000 of drilling equipment, U.S. \$38,000 of Geophysical, Field Camp and Survey items, U.S. \$2,700 of Drawing Office equipment and U.S. \$25,200 of Laboratory equipment. In addition, two vehicles were acquired. This equipment still remains the property of the United Nations but has remained with the Department.

The drilling equipment has been particularly valuable, enabling preliminary test to be made of certain of the various mining targets that have been established. The laboratory has benefitted by a very important item of equipment, a large Quartz Spectrograph, which has greatly increased the productivity in analyses.

Although subject to certain difficulties both technical and otherwise which led to the programme falling severely behind schedule, the project is regarded by the Department as highly successful. It has already given considerable guidance in mineral exploration, and the data will continue to do for many years hence.

The Government and the Geological Survey is much indebted to the United Nations, the personnel of the Office of Special Fund Operations in New York and those engaged in the project in British Guiana, the successive Project Managers Mr. G. Shaw and Mr. E. Wicherts, and the contract crews.

The results of the project are recorded in the Project Manager's report which will be issued shortly by the United Nations, and the two reports by the airborne contractors, Aero Service Corporation of Philadelphia (aeromagnetics) and Canadian Aero Mineral Surveys Ltd. of Canada (Airborne E.M.).

The contractors' reports are not yet generally available, although they may be consulted at the Geological Survey in Georgetown. Whilst it is proposed to publish the contractors' reports it is not at present envisaged that the maps will be printed since over 100 are involved. Dyeline copies are available from the Department.

The airborne magnetic programme was carried out with an Aero Commander aircraft flying at 1000 ft. terrain clearance and using a Gulf Mk III Fluxgate magnetometer. The flying paths were controlled by a doppler navigational system and recovered by continuous tracking camera records. As mentioned in the Introduction of this report airborne magnetic data can be of considerable value in assisting geologic interpretation and can also be a direct guide to magnetic ore bodies.

The airborne E.M. work was carried out from a Canso aircraft equipped with a Mark III INPUT System of Selco Exploration Ltd, and Barringer Research Limited of Toronto. Briefly, in this system, electromagnetic pulses are transmitted from a horizontal transmitting loop hung from wingtips, nose and tail of the aircraft. The pulses generate currents within conductive bodies in the ground which in turn create their own electromagnetic fields. Certain characteristics of the secondary fields are measured through a vertically mounted receiving coil towed in a streamlined container about 500 ft. behind the aircraft.

For these surveys the aircraft flew at about 400 ft. above the ground, the flight paths again being controlled by a doppler navigation system, and recovered by continuous tracking camera records. The tracking camera films of both aeromagnetic and airborne E.M. surveys are retained at the Geological Survey.

The contractor's Geophysicists, Mr. K.N. Issacs and Mr. A.R. Rattew reporting on the airborne magnetic phase drew attention to eight localities regarded as of particular interest. Certain of these have already been investigated; others await attention.

On the electromagnetic data the contractor's Geophysicist, Mr. A.R. Rattew, has advised that 52 localities of airborne response appear to deserve special consideration, grading these as 17 of first 16 as second, and 19 of third priority.

It is gratifying that the E.M. report advocates checking techniques that completely accords with current Geological Survey procedures.

B. Counterpart Field Operations

Counterpart to the United Nations contribution largely took the form of mineral exploration surveys undertaken by the Department as tabulated below:-

Year	Geologist	Locality Departmental Report No.	Area	Departmental Report No.	Operation	Mineral- isation
1962 2nd Season	C.N. Barron) F. Guardia)	Haimaralli	Central Cuyuni	CNB. 3/62 4/63	Drilling	Cu, Zn
	P.M. Allen	Barama	Upper Barama Upper Cuyuni	PMA 4/63	Reconn- aissance	-
	M.G. Allderidge	Merume	Middle Mazaruni	MGA 1/63	Prospect- ing	Cr
	S. Singh	Kanukus	Kanukus	SS 1/63	Reconn- aissance	-
	J.W. Carter	Haimaralli	Central Cuyuni	JWC 1/63	Geo- chemistry	Cu
1963 1st Season	C.N. Barron) F. Guardia)	Aranka	Central Cuyuni	CNB 1/64	Geo- chemistry	Cu, Au
	L.L. Fernandes	Akaiwong	Central Cuyuni	LLF 3/63	Geo- chemistry	Au
	J.H. Bateson	Waiamu	Central Cuyuni	JHB 3/63	Reconn- aissance	-
	P.M. Allen	Akarabisi	Upper Cuyuni	PMA 4/63	Reconn- aissance	-
	M.W. Carter	Haimaralli	Central Cuyuni	-	Drilling	Cu, Zn
	M.G. Allder-) idge) J.W. Carter)	Eldorado	Mazaruni	JWC 1/64	Survey	Au

Year	Geologist	Locality Departmental Report No.	Area	Departmental Report No.	Operation	Mineral- isation
2nd Season	C.D.G. Black) R.H. Hewins)	Haimaralli	Central	CDGB 1/64	Drilling	Cu, Zn
	F. Guardia	Ewang	Potaro	GS.AX. 150 (a)	Geo- chemistry	-
	J.W. Carter	Honey Camp	Mazaruni	JWC 2/64	Survey	Au
	L.L. Fernandes	Matthew's Ridge	N.W.D.	LLF 4/63	Survey	Mn
1964 1st Season	C.D.G. Black	Haimaralli	Central Cuyuni	CDGB 1/64	Drilling	Cu, Zn
	J.W. Carter	Aremu	Aremu	-	Survey	Au
	S. Singh	Wariri- Kopang	Lower Cuyuni	SS 1/64	Reconn- aissance	-
	C.N. Barron	Aranka	Central Cuyuni	CNB 2/64	Geo- chemistry	Cu, Au
	R.H. Hewins	Mariwa	Lower Cuyuni	RHH 1/64	Geo- chemistry	Au, ? Ni
		Groete Creek	Lr. Ess- equibo	RHH 1/64	Geo- chemistry	Au, Cu
	L.L. Fernandes	Putareng	Mazaruni	LLF 1/64	Survey	Fe
	G. Sampson	Merume	Mazaruni	MR 9/1	Prospect- ing	Cr
	E.R. Biggs) J.H. Bateson)	Eagle Mt.	Potaro	ERB 1/64) JHB 4/65)	Geo- chemistry	Mo
		F.L. Guardia	Itobi	Mazaruni	FJL 1/64	Survey
	R.T. Cannon	Mariwa	N.W.D.	RTC 1/64	Reconn- aissance	Ni

Year	Geologist	Locality Departmental Report No.	Area	Departmental Report No.	Operation	Mineral- isation	
2nd Season	E.R. Biggs	Dukwarri Head	Upper Cuyuni	ERB 3/64	Reconn- aissance	-	
	C.D.G. Black	Haimaralli	Central Cuyuni	CDGB 1/65	Drilling	Cu, Zn	
	P.B.H. Bailey) G.A. Sampson)	Pomeroon Head	Pomeroon	GAS 1/65	Survey	Fe	
	F.L. Guardia) G.N. Rodwell)	Itaki	Mazaruni	FLG 1/65 GNR 1/65	Geo- chemistry Geophysics	Base Metal indicati- ons	
	R.H. Hewins	Tikwah	Mazaruni	RHH 1/65	Geo- chemistry	Au	
1965 1st Season	J.H. Bateson	Wariri	Lower Cuyuni	JHB 1/65	Geo- chemistry	Ni, Au	
	P.B.H. Bailey	Aranka	Central Cuyuni	-	Drilling	Cu, Au	
	S. Singh	Pap Is- land- Waiamu	Lower Cuyuni	SS 2/65	Reconn- aissance & Geo- chemistry	Mn Graphite Ni ?	
	G.A. Sampson	Aremu	Aremu	GAS 2/65	Geochem- istry	Au, Cu	
	G.N. Rodwell	Haimaralli	Central Cuyuni	Lower) Cuyuni) Aremu) Peter's) Mine)	GNR 4/65	Geo- physics	-
	J.R. Briggs	Groete Creek	Lr. Ess- equibo	Rept. by J.R. Mac- Donald	Prospect- ing	Cu, Au	
W. Miller	Rupununi	Rupununi	Rept. by E. Wicherts	Drilling	-		

Year	Geologist	Locality Departmental Report No.	Area	Departmental Report No.	Operation	Mineral- isation
	C.N. Barron	Peter's Mine	Puruni	Rept. by J.R. MacDonald	Drilling	Au
2nd Season	C.N. Barron	Area 33	Puruni	-	Drilling	Airborne response
	G.A. Sampson	Wairi	Lower Cuyuni	GAS 1/65	Geo- chemistry	Ni, Au, Cu.
		Aremu	Aremu	GAS 1/65	Geo- chemistry	Au, Cu, Ni.
	G.N. Rodwell	Tassawini	N.W.D.	GMR 5/65	Geophysics	Au
		Area 33	Puruni	GMR 6/65	Geophysics	Airborne Response
	S. Singh	Yakishuru	N.W.D.	-	Drilling	Au, Mo
		Kokerit	N.W.D.	-	Geo- chemistry	Results awaited
		Tassawini	N.W.D.	-	Geo- chemistry	Results awaited
		Pipiani	N.W.D.	-	Geo- chemistry	Results awaited
		Ianna	N.W.D.	-	Geo- chemistry	Mo, Au

The reports listed above and the numerous maps associated with them are available for inspection at the Geological Survey Headquarters. Some may be obtained as cyclostyled copies.

Efforts are being made to reproduce these counterpart reports as soon as possible in the Records of the Geological Survey. At this stage, however, it appears appropriate to review briefly the results of the work undertaken as counterpart to the U.N. Project, and to discuss in rather greater detail in certain cases the conclusions derived. It should be realised that some investigations become long drawn out if encouragement to continue is obtained and follow-up continues.

1) Haimaralli (Puruni N.W.)

The activities at this locality are of particular significance in that they represented the Department's first diamond drilling operation and resulted in establishing the first securely substantiated record of subsurface base metal mineralisation in the country, and perhaps in the entire Guiana Shield. Copper and zinc mineralisation was encountered and, although the values met were generally low the exploration interest of this general area of the country has certainly been enhanced in a minor showing of the secondary mineral Brochantite in metasediments in the vicinity of Haimaralli Falls. This discovery led to drainage reconnaissance geochemistry together with geologic observation over forty square miles of adjacent territory. Five localities of apparent interest were established and one of these, the so called Area A selected for additional work. Soil sampling revealed a geochemical soil copper anomaly which it was decided to drill.

Later operations were concentrated up the immediate vicinity of the original brochantite discovery. The more significant results may be summarised as follows:

Hole No.	Length of Intersection (Ft.)	% Copper	Length of Intersection (Ft.)	% Zinc
DDH/14	12	0.6		
DDH/15	4	0.6		
	5	0.6		
	9	0.9		
	8	1.3	10	0.7
	27	0.7		
	8	1.1		
	10	0.6		
	5	0.9		
DDH/20			11	0.8
			6	0.7

average of 0.4 % zinc was recorded.

2) Barama-Akarabisi

P.M. Allen undertook studies in the upper Barama-Akarabisi region in the second field season of 1962 and the first of 1963. This work included previously unmapped areas and was accompanied by reconnaissance geochemistry. Suggestion of Geochemically anomalous areas of lead and copper was obtained which will require follow-up in more detail.

3) Merume

On several occasions the Geological Survey has endeavoured to establish the source and origin of the unusual chromium mineral Merumite, first discovered in 1937 in the Merume valley. During the course of the project M.G. Allderidge during the second season of 1962 and G.A. Sampson in the first season 1964 further defined the area of occurrence, but the reason for the occurrence and concentration of the mineral in this locality remains a problem still to be solved.

4) Kanukus

In 1962 S. Singh continued his studies in the southern Rupununi Savannas to the border of the Kanukus. Several small magnetite bodies have been mapped by C.N. Barron and Dr. Singh in this area. None at present appears of economic proportions although aeromagnetic anomalies in the Kanukus remain to be examined on the ground.

5) Aranka

In 1963 C.N. Barron and F.L. Guardia undertook geochemical reconnaissance over about 50 square miles in the Aranka region, known to have yielded much alluvial gold in the past. Five areas of possible interest were indicated. Two were rejected as unimportant. Another was subsequently drilled and two remain for further examination.

Geochemical work was continued in 1964 and a soil copper anomaly of evident interest developed in an area known to be comparatively rich in alluvial/eluvial gold. Drilling was undertaken in 1965, results being recorded in Section IV. Copper-bearing intersections of distinct interest were encountered, some sections carrying gold.

The area clearly deserves more attention, particularly in light of the airborne E.M. data now available.

6) Eagle Mountain

The Geological Survey operations at Eagle Mountain were mentioned in the Annual Report for 1964. Although certain geochemical orientation studies continue the main programme has now been concluded. Mr. J.R. MacDonald, U.N. Economic Geologist, prepared a compilation of the data during 1965. The locality appears to hold possibility of large tonnage molybdenum production.

Eagle Mountain has a long record of gold production from alluvial and small scale auriferous quartz vein operations. In 1948 the Anaconda Company carried out a substantial amount of exploration for gold including nearly 20,000 ft. of diamond drilling and over 2,000 ft. of tunnelling. The work failed to establish a deposit workable on a large scale. During the operations molybdenite was encountered, the report on the project mentioning a drill hole intersection of 93 ft. averaging 0.14 $\frac{\circ}{\circ}$ Mo.

This report led to the Geological Survey initiating a comprehensive geochemical soil sampling programme for molybdenum. Nearly 10,000 samples were collected and analysed. The work was rewarded by the identification of two pronounced geochemical soil molybdenum anomalies, one in the general area of the Anaconda discovery and another in the Dickman's Hill region.

The Department has not undertaken drilling upon the anomalies, it appearing inevitable that they would attract mining company attention, this proving (1966) to be the case.

7) Akaiwong (Middle Cuyuni)

In 1963 geochemical work was carried out by L.L. Fernandes at Akaiwong an eluvial and alluvial gold area which has yielded nuggets of exceptional size comparatively recent past although now virtually abandoned.

Detailed soil sampling was undertaken on a systematic grid and an E-W zone of anomalous soil copper values was established. The zone is some 600 feet wide and 2,000' long. Further work is clearly indicated.

8) Waiamu

J.H. Bateson in 1963 and S. Singh in 1965 undertook geological and geochemical reconnaissance in the Waiamu area of the Lower-Middle Cuyuni. The renewed work of 1965 was suggested by airborne E.M. response and included ground E.M. work by G.N. Rodwell, Geophysicist. On the whole the geochemical work was disappointing and the conductive bodies that were checked appear to be graphitic zones. Copper indications in the vicinity of a small quartz diorite stock and the wide extent of airborne E.M. response afford encouragement for further exploration, however.

9) Eldorado-Kaburi

Surveys were undertaken during 1963 by J.W. Carter, M.G. Allderidge and others in the Eldorado-Kaburi district, long known of interest for the occurrence of important auriferous quartz veins. The surveys formed part of a larger programme then under Mr. Carter, of examining the Honey Camp-Omai "gold belt", yet to be completed. Airborne response over this block was disappointing and flying was consequently curtailed. Progress was made however in the understanding of the geologic controls of the gold mineralisation of the area.

10) Potaro-Ewang

Following reports of copper mineralisation in the Patience Creek area of the Potaro-Ewang geochemical surveys were initiated. Results were discouraging.

11) Honey Camp

Pursuing the programme mentioned under area 9 above investigations were carried out in 1963 on the Honey Camp goldfield. Structural and lithologic controls of mineralisation were suggested and the geochemical association of chromium with gold in this area was demonstrated.

12) Matthew's Ridge

Observations by Mr. L.L. Fernandes on the minor structures displayed in the open cast manganese mine of Manganese Mines Management Ltd., at Matthew's Ridge supported the contention that the mine lies on the northern side of a major fold.

Airborne E.M. traverses to check on the ability of the technique to pick up manganiferous horizons showed that whilst some response was obtained, it is unlikely to be of significant assistance under British Guiana conditions. Ground E.M. work carried out by Mr. G.N. Rodwell showed little conductivity contrast between the manganiferous horizons and wall rocks.

13) Aremu

In 1964 surveys were undertaken by J.W. Carter in the Aremu Mine area. The Aremu mine, long abandoned, has some surface workings and was much later subjected to a diamond drilling exploration programme by the Anaconda Company.

Airborne magnetic operations encouraged continuation of the work and a major geochemical programme was initiated in 1965 under Mr. G.A. Sampson. As recorded under Section IV the surveys have established the occurrence of geochemical soil copper and nickel anomalies. Operations continue, accompanied by ground geophysics.

The region is of such evident exploration interest that, in anticipation of drilling, the Department is extending the old Kartabu-Oko road towards the Aremu.

14) Mariwa

During the first field season of 1964 R.H. Hewins undertook a broad grid geochemical soil sampling programme in the Mariwa area of the Lower Cuyuni. Results were inconclusive but suggest that further follow-up work should be carried out. Some additional geochemical work was performed in 1965 in check upon airborne EM anomaly. The results in this case suggest a formational conductor but the area as a whole remains of interest.

Groete Creek, Lower Essequibo

During the same season as the Mariwa operation R.H. Hewins undertook similar geochemical work in the Groete Creek region, with much more positive results. Anomalous copper values were indicated and subsequently (See Section IV) a pronounced geochemical copper anomaly was established in a locality which yielded much gold in the earlier years of the country. As a result company exploration is now taking place.

16) Putareng

Airborne magnetics showed a pronounced but small dipole magnetic anomaly in the Putareng valley at a locality of known iron mineralisation. Studies by L.L. Fernandes in the first field season of 1964 established the occurrence of magnetite bodies, the major one of which was estimated to carry about three million tons of magnetic per hundred feet of depth.

17) Itaki

One of the most pronounced magnetic anomalies shown by the United Nations airborne work occurs over the Itaki Hills, Mazaruni. The area was investigated geochemically and geologically by F.L. Guardia with geophysical work carried out by G.N. Rodwell.

The cause of the anomaly was found to be a basic igneous body, in parts rather strongly magnetic.

Geochemical work produced a weak Nickel/Copper/Zinc anomaly which, carrying no accompanying ground E.M. response may not be of material significance.

In anticipation of drilling an 18 miles trace was opened by J.R. Briggs, Field Observer, but, in the event, not used by the Geological Survey. It has however proved of value to others.

18) Middle Barama (N.W.D.).

During the first season of 1964 regional reconnaissance was accompanied by a limited programme of sampling in laterites. The results appear to be of interest and demand further attention in view of the possible occurrence of economic concentrations of nickel in the laterites. The presence of ultrabasic bodies was established and two shallow pits in the laterite show increasing nickel content in depth. Maximum values only attained 1000 parts per million Ni but in nickeliferous laterite deposits best grades normally occur near the base.

19) Dukwarri Head (Upper Oyuni)

This rather remote area was suggested for survey by aeromagnetic data but no results of recognisable economic significance were obtained. The surveys were undertaken by E.R. Biggs.

20) Pomeroon Head

Following up a report of several years ago by P. Hall, Geologist of the African Manganese Company, of a haematite occurrence in the upper Pomeroon; P.B.H. Bailey and G.A. Sampson investigated the indicated area during the second field season of 1964. Three haematite bodies were encountered. It will require drilling to establish the exact extent of the deposits but a minimum figure of 25 million tons has been estimated.

21) Tikwah

Also during the second season of 1964 R.H. Hewins carried out geochemical investigations in the vicinity of the old Tikwah gold mine in the Mazaruni. Analytical work on samples had to be deferred but has now been performed. As far as plotting has proceeded it does not appear that results of particular note were obtained.

22) Kurupung

Endeavour was made on two different occasions by G.A. Sampson and then R.H. Hewins to locate on the ground the cause of an aeromagnetic anomaly in the vicinity of the Kurupung River. The work was unsuccessful but it is uncertain whether the exact area was traversed; geologic observation is rendered difficult by a blanket of superficial sands.

1965 Operations

Counterpart operations for the United Nations Special Fund Scheme during 1965 are detailed in Section IV.

Summary of Results of Counterpart Field Operations

During the course of the United Nations Project Haimaralli (Cu/Zn), Aranka (Cu/Au), Aremu (Au/Ni/Cu), Eagle Mountain (Mo), Peter's Mine (Au), Wariri (Ni/Au/Cu), Groete Creek (Au/Cu), Ianna (Mo); and Yakishuri (Au/Mo), although all known as gold mineralized areas had their interest greatly enhanced. In most cases the occurrence of metals other than gold had not previously been shown. A considerable amount of new information was obtained concerning two more localities, both iron deposits, at Putareng and Pomeroon.

No ore bodies were demonstrated as such, this was scarcely anticipated but appropriate exploration in detail by mining company exploration and following the guide given by the scheme may very possibly show workable deposits to be included in the list above.

The data of the airborne surveys, the ground experience gained, and work currently in progress, will undoubtedly continue to produce new exploration targets of equal interest at comparable rate to that achieved during the project itself.

Counterpart Finance

Cost to the Government of British Guiana of the U.N. Scheme is estimated at U.S. \$786,372 distributed as in the table below. This total represents about 53 ⁰/₀ of the overall cost.

British Guiana Government Counterpart contribution to the Aerial Geophysical Survey - Expressed in U.S. \$

	Personal Services	Equipment & Supplies	Miscellaneous	Total
2nd half 1962	48,800	22,500	16,200	87,500
1st " 1963	73,456	23,236	18,265	114,957
2nd " 1963	40,352	21,029	12,800	74,181
1st " 1964	88,194	15,780	13,321	117,295
2nd " 1964	94,793	15,574	16,865	127,288
1st " 1965	101,361	13,712	11,979	138,242
	560,107	124,480	101,785	786,372

IV. Field Work 1965

As has already been noted field operations were severely hampered by shortage of staff. Nevertheless very important progress was made and has given cause for considerable satisfaction.

In the past, individual mapping programmes, although designed to fit into the overall policy of extending regional coverage, could to certain extent be regarded as self-contained operations capable of complete reporting soon after the conclusion of the field season during which they were undertaken. Present activities are of different nature and may progress from preliminary reconnaissance through increasing detail to drill operations. Such may extend over two, three seasons, or even longer and the larger amount of analytical work involved itself powerfully controls rate of progress. The analytical work itself may require repetition for additional elements as later studies dictate.

Another change that has taken place with introduction of drilling is wet season work. Static operations, as at drill camps can be carried on continuously throughout the year at many localities, and this brings an additional burden on supporting facilities.

The structure of the Department is in progress of adjustment to meet the changing needs but precise requirements take time to materialise, assess and meet.

The distribution of activities during 1965 was as follows:

Aranka	Drilling	P.B.H. Bailey & J.H. Bateson
Peter's Mine	"	C.N. Barron
Area 33	Drilling) Geochemistry) & Geophysics)	C.N. Barron and G.N. Rodwell
Wariri	Geochemistry	J.H. Bateson & G.A. Sampson
Groete Creek	Geochemistry & Geophysics	J.R. Briggs (Field Observer) C. Rambali (Field Assistant) G.N. Rodwell
Aremu	Geochemistry & Geophysics	G.A. Sampson & G.N. Rodwell
Pap Island-Waiamu	Geochemistry & Geophysics	S. Singh & G.N. Rodwell
Yokishuru	Drilling & Geochemistry	S. Singh
Ianna	Geochemistry	S. Singh
Pipiani	Geochemistry	S. Singh
Kokerit	Geochemistry	S. Singh
Tasawinni	Geochemistry & Geophysics	S. Singh & G.N. Rodwell
Takutu Basin	Drilling	W. Miller (Field Assistant)
Eagle Mountain	Banka Drilling	V.A. Agrippa (Senior Field Assistant)
Kamarang-Kako Area	Sample Collection) for Palaeomagnetism)	R. Henry & S. Jagai with Professor Hargraves
Potaro & Upper Potaro Area	do.)

As a measure of staffing weakness it may be pointed out that at full strength the number of localities under investigation would have been more than doubled.

Wariri

During the first field season the geology of a small area around the old Wariri Mine, Cuyuni River, was examined by Mr. J.H. Bateson, Senior Geologist. Attention was directed to this area, which has had a long history of gold recovery, from minor operations on auriferous reefs and from adjacent creeks, by the occurrence of several airborne E.M. responses, regarded as having favourable characteristics. One of these electromagnetic anomalies extends for some 3000 ft. along a roughly E-W strike in the vicinity of the disused Wariri Mine.

It was established that amphibolites of various types dominate the area with leucocratic granite intrusives occurring locally. A granite offshoot of the Quartzstone-Aremu batholith occurs in the extreme northwest of the area. Of particular possible importance was the identification of an ultrabasic body which occurs about 5000 feet to the south east of the Wariri Mine; the precise extent is uncertain owing to the paucity of exposures.

Geological observation was not able to establish the cause of the airborne response near the mine but it evidently lies close to the ultrabasic body.

Geochemical surveys gave interesting results. Some 8 % of the samples collected fell in the anomalous group with a maximum of 240 parts per million. Nickel values were generally high, giving a threshold for the area of 300 ppm. Occasional values up to 2000 ppm occurred. For Zinc some 2 % of the values fell within the probably anomalous values of greater than 740 ppm, whilst chromium also showed some 9 % of values in the probably anomalous range. Occasionally samples contained up to 3 % Cr.

Additional geochemical work in the second field season by Mr. G.A. Sampson confirmed and extended the geochemical soil nickel anomaly and a limited programme of shallow pitting produced nickel values up to 0.4 % nickel in the laterite.

These results clearly suggested the possibility of a nickeliferous laterite and perhaps nickeliferous sulphides below. As analytical work progresses a geochemical copper anomaly also appears to be developed.

Early in 1966, report of the data led to the interest of Sherritt Gordon Mines Ltd. of Canada which sought and was granted an exclusive exploration permission over 100 square miles in the Wariri and adjacent regions. Both ground operations and additional aerial geophysical surveys are proposed.

Groete Creek

During 1964 the Department undertook a reconnaissance geochemical soil survey on a systematic grid in the Groete Creek area, an area which produced substantial quantities of gold from the alluvial workings up to about 1910. Native copper was also reported in the gravels. The initial geochemical surveys covered an area of approximately six square miles, traverse lines being on the wide spacing of 1500 ft. Despite the highly reconnaissance nature of this survey anomalous areas were indicated.

Appraisal of the data by Mr. J.R. MacDonald, U.N. Economic Geologist led to a surface prospecting programme during the first field season of 1965 under charge of Mr. J.R. Briggs, Field Observer. Sampling from trenches sunk by Mr. Briggs, yielded abnormally high copper values, reaching in one case 3% copper and in this particular trench an overall copper content of 0.52%.

A detailed soil sampling survey followed under Mr. C. Rambali, Field Assistant, defining an anomalous zone 3000 feet in length and approximately 400 ft. wide with amplitude ranging up to 1200 parts per million copper against a background of 100-200 ppm. Subsequent ground EM (Turam) surveys carried out by Mr. G.N. Rodwell yielded coincident responses to the geochemical "highs".

The locality is of considerable exploration interest and has, in fact, since (1966) come under an exclusive Exploration Permission granted to Torbrit Silver Mines of Canada jointly with Guyanese participation. One of the attractions of the prospect is its readily accessible position, being only a few miles from tidewater on the Essequibo River and within ready reach of Bartica.

Yakishuru

Work by Dr. D.A. Bryn Davies in 1937 established that the surface gold workings of Yakishuru, N.W.D. are related to a small granite stock, the main operations being situated on NW-SE auriferous shear zone on the northern margin of the stock.

This earlier work by the Geological Survey has long provided an obvious drilling target and equipment was transferred to Yakishuru for drilling operations during the second field season 1965. Dr. S. Singh was allocated charge of the expedition which completed five drill holes together with an accompanying geochemical survey.

Assay results on the drill cores are still awaited but the drilling showed that the granite (alaskite) stock is molybdenite-bearing.

Holes No. 1, No. 2, and No. 3 were directed to cut the auriferous shear below the zone of weathering. Yellow sulphides were encountered and arsenopyrite was fairly prominent. Molybdenite was noted when drill hole No. 3 intersected the stock and was also observed in DDH No. 4, along the presumed extension of the shear zone beyond the granite. A fifth hole sunk entirely in the granite carried significant values of Mo (average approximately .05% Mo) throughout its 450 ft. length, with 2 ft. sections carrying up to .4% Mo.

Geochemical work over the stock and in the vicinity demonstrated anomalous molybdenum values over certain areas.

The combination of the gold bearing shear zone in close juxtaposition to the molybdenite bearing stock render this locality an evident target for further exploration. The region as a whole warrants careful exploration: a belt of metasediments between two large granite masses, the Teki to the North and the Aranka-Wanamu to South, with many known gold occurrences, the molybdenite discovery, and the occurrence of minor granite stock of similar appearance to Yakishuru all suggest a favourable environment for economic mineralisation.

Whilst undertaking the Yakishuru work Dr. Singh also supervised geochemical work over adjacent regions of Ianna, Pipiani, Kokerit, and Tasawinni. Owing to the shortage of Senior Professional staff direct responsibility for the operations was delegated to the field assistant: V.A. Agrippa, P. Assanah, W. Miller and L. Armstrong all of whom very commendably executed the duties. In this connection it may be mentioned that particular difficulty was experienced in those surveys as a result of the unusually low stage of the rivers, rendering servicing of the expeditions a matter of many formidable problems.

Ianna

A detailed geochemical programme was carried out at Ianna across the northern margin of the Ianna granite, known to be mineralised. Prospecting failed to locate any notable concentrations of alluvial or eluvial gold although eyes of gold were obtained from most washings.

Analysis of soil samples continues; geochemical soil molybdenum anomalies are materialising and it would appear that the Ianna stock, like the Yakishuru stock is molybdenum mineralised at least in part.

Pipiani

A geochemical soil sampling programme was carried out in the Pipiani goldfield area. The samples await analysis. Results of gold prospecting were disappointing.

Kokerit

A detailed geochemical soil sampling programme was carried out. As with Pipiani the locality was selected on the basis of known occurrence of alluvial gold. The results of gold prospecting were, however, disappointing.

Tasawinni

The Tasawinni area appears to be of particular promise. Bullion recovered from past operations contains only 20-30 ‰ gold and there is thus prospect of other valuable metal content. There is in fact, other evidence suggesting the Northwest District as presenting potential in silver and allied metals.

Brief reconnaissance with ground E.M. by the Geophysicist, Mr. G.N. Rodwell, in the immediate vicinity of the Old Tasawinni Mine area produced results of no recognisable significance.

Aranka

During the first field season drilling was undertaken at Aranka in the Central Cuyuni area. The background of the operation is briefly described in Section III. Preliminary work started in 1964 when Mr. A.O. Edwards, Field Observer under the direction of Mr. C.D.G. Black commenced the task of driving an eleven mile equipment and supply trail from the Cuyuni to the drillsite area. This continued in 1965 when several streams were bridged including the Aranka itself, some 200 feet wide at the crossing.

Four drillholes were sunk, traversing the geochemical/gold anomaly previously established. The results were encouraging in that they clearly point to the region as encouraging further exploration.

DDH No. 1 commenced drilling on 27th March 1965 and was completed on 10th April 1965. It was taken to 760 ft., and inclined at the surface 45° northward. After passing through 164 ft. of overburden it encountered greywacke type metasediments with some basic intermediate intrusions most prominent in the upper part.

Pyrite and chalcopyrite are present as minor constituents throughout most of the core. Both minerals obtain some prominence at 275' and 370'. Chalcopyrite itself is noticeable from 490' to 650' and most prominent between 605'-608', 623'-630', 658'-662' and 692'-694'. Where sulphides are best developed there is an increase in carbonate.

Analyses of the cores gave 0.85% Cu for a 3 ft. intersection 494'-497' and rather disappointing values elsewhere although 620' to 626' carries 0.26% Cu.

DDH No. 2, 384' due north of Aranka No. 1, was drilled 801' at a surface inclination of 45° . Commenced on 15th April 1965 it was completed on 2nd May 1965. Coring was carried out from 201 to 801'.

Two main lithological types were encountered. From 201'-454' a sequence of fine grained rocks, probably lavas, occur. Below 454' a medium grained acid rock was met, probably a marginal type of neighbouring Aranka batholith.

Sulphides were observed throughout but as a minor constituent only.

Analyses of cores yielded 0.65% Cu over the two foot intersection 250'-252'; 0.3% from 317' to 320'; 0.5% from 342' to 347', 0.5% from 365' to 369'; 0.7% from 484' to 486' and 0.5% from 533 to 537 ft.

Aranka DDH No. 3 met the best results encountered. It was drilled vertically from the same site as DDH No. 1 and carried to 1001'6".

Metasediments comprised the main part of the core below the overburden although thin intrusions occur at 160'-164 $1/2$ ' and 187'-193 $1/2$ '.

Pyrite and chalcopyrite occur, mainly as minor disseminations throughout the core but become less prominent below 800 ft.

Analysis of Aranka No. 3 core yielded an intersection of 129' running 0.36% from 323' to 452'.

Sludge values were on occasion higher than core values for certain section of these drill holes. This is a circumstance that is not uncommon in such operations and may sometimes be ascribed to attrition of mineralised fracture planes during drilling. An internationally accepted equation for combining sludge and core results improves the value for Aranka No. 3 and suggests the best intersections as:-

351'-370'	19' x 0.83% Cu
391'-410'	19' x 0.74% Cu
421'-450'	29' x 0.73% Cu
or from 330'-450'	120' x 0.63% Cu

This final result should be treated with reservation since it cannot be certain that the assumptions inherent in the formula are precisely applicable in this case. The drilling has undoubtedly demonstrated that this region is a promising exploration area, particularly when the incidence of airborne anomalies recommended for investigation is taken into account. One such anomaly is situated quite close to the drilled area. Within the immediate region as covered by the appropriate aero-electromagnetic data sheet (Puruni N.W. 2) 10 of the total of 51 recommended E.M. targets occur. In addition the geochemical drainage reconnaissance of 1963 (Barron and Guardia, G.S. Report No. CNB 1/64) suggested other geochemically anomalous areas. The resumption of geochemical reconnaissance of the region is clearly warranted.

A fourth drill hole Aranka No. 4 yielded uninteresting copper values in the sludge samples and hence further analytical work has been temporarily deferred.

Takutu

As noted in the 1964 Annual Report a drilling programme was initiated in the latter part of the year, traversing the northern Rupununi Savannas in an attempt to establish something of the stratigraphy and structure of the sediments within the Takutu Basin.

Interest in the basin was greatly enhanced by airborne magnetic traverses carried out during the United Nations Aerial Geophysical Programme and as an extension to the flying of the Kanku Mountains. Mr. G. Shaw, Project Manager of that time immediately designated the basin as one of considerable depth. During 1963, gravimetric observations undertaken by Masson-Smith and Andrew of the Directorate of Overseas Geological Survey provided supporting data suggesting that the thickness of sediments overlying the basement locally attain as much as 20,000 ft.

Mr. E. Wicherts, second Project Manager of the U.N. Project re-appraising the geophysical data concluded that the northern edge of the basin is bounded by major faults and that on the basis of the magnetic records the depths to basement are of considerably lesser order than suggested above, perhaps half, and postulated the occurrence of evaporites to account for the discrepancy between gravity and magnetic interpretations. The suggestion is of considerable interest and the possibility is supported by the red-bed nature of the sediments encountered and the near-shore element noted in the palynological assemblages.

Six sites were selected on the basis of existing maps, the aeromagnetic and gravity data, air photography and a visit to the area by Mr. C.N. Barron.

A total of five holes were eventually drilled in the programme. Mr. W. Miller, Field Assistant undertook administrative duties connected with the field work and Mr. E. Wicherts, Project Manager, logged the boreholes. The following summarises:

Takutu No. 1, located at St. Ignatius near Lethem was abandoned at 100 ft. owing to a mechanical failure in the drilling rig. Takutu No. 2 at the same locality was carried through 60 ft. of overburden and then to 342 ft., mainly in red-brown to purple mudstones with increasingly sandy element below 200 ft.

Takutu No. 3, was located near Pirara in the central part of the Takutu Basin. After 75 ft. of overburden, red to brown stained fine to medium grained sandstones of continental facies continued to the bottom of the hole at 350 ft.

Takutu No. 4, was drilled one mile south of Toko on the up-throw side of the northern boundary fault of the basin, granite was encountered at 40 ft.

Palynological work is being carried out on samples from the cores by Professor Th. van der Hammen of Leiden University. Pollen from 234-237 in Takutu No. 5 suggested on Preliminary examination a Jurassic to Lower Cretaceous in age.

The report in preparation by Professor van der Hammen on the pollen assemblages is awaited with considerable interest and should become available in 1966.

The Aremu

The Aremu area has long been of evident interest. Although the area itself is situated approximately midway between the Cuyuni and Mazaruni rivers, the Aremu itself flows into the Cuyuni. At one time a small gold mine operated, producing 6,500 ounces of gold at about the end of the first decade of the century. The Anaconda Company completed a considerable amount of drilling during the latter part of the 1940's and at various times the Geological Survey has operated in the region.

The Geological Survey renewed investigations in 1963 when J.W. Carter undertook a study of the general vicinity of the mine including geochemical surveys. Activities were renewed during 1965 by Mr. G. Sampson and still continue.

Both the airborne magnetics and airborne electromagnetic programmes of the United Nations Special Fund Project have produced guiding data of value and interest.

The airborne magnetic surveys show an elongated anomaly sharply interrupted at the old Aremu Mine. A series of strong first and second channel EM anomalies, have occasionally third channel responses, coincide with the magnetic belt. In addition, isolated anomalies occur within the general regions.

During 1965 geological work was extended from the mine area eastwards towards the Oko, and was accompanied by geochemical and geophysical programmes.

The region, which lies on the southern margin of the Quartzstone-Aremu batholith is underlain predominantly by soft red or purple mudstones, phyllites and schists of the Mazaruni Group. In the northeast hornblende gneisses and schists have developed as a result of an intrusion and contact effects on basic country rocks. Mr. Sampson was not able to concur with the earlier suggestion that gneissic rocks of this suite can be correlated with the Bartica Assemblage. Older basic intrusives, quartzites, and sericite schists have also been observed. Regional foliation is east-west except where it parallels the periphery of the granite.

Geochemical surveys, analytical data for which is yet incomplete, has outlined four main areas of interest.

- a) An area of anomalous copper values associated with visible copper mineralisation. Analysis of one sample of amphibolite containing disseminated chalcopyrite, covellite, and pyrite gave up to 1.3 % Copper. The position of this occurrence corresponds approximately with the conductive zone indicated by the airborne survey.

Soil sampling was carried out in the vicinity of the copper bearing float and an anomalous zone about 1,000 feet long and 200 feet wide indicated. Maximum soil values reached 540 ppm. against a background of less than 100 ppm. A few shallow pits were sunk, in one of which the copper content attained 1,000 ppm.

This area is now being examined with ground EM and other geophysical methods. On the firm anticipation that drilling will be required, the old Oko Road is now being reopened by the Department. It is intended to continue the access road to the Aremu Mine itself.

- b) Geochemical work in the immediate area of the Aremu Mine area was carried out in 1964 but analytical data did not become available until 1965.

Gold mineralisation occurs in quartz veins associated with graphitic schists; mapping has shown the occurrence of various sulphides associated with the gold mineralisation. A NNW trending fault zone has been shown to affect the country rock in the vicinity of the mine and this structural break is reflected in the airborne geophysical data.

Anomalous soil copper values occur in a narrow belt about 1,500 ft. northwest of the old Aremu shaft, extending NW-SE for about 2,000 ft. Local anomalous zinc values partially overlies the copper anomaly.

- c) Abnormal soil nickel values have been encountered on a small hill about 1 1/4 miles northwest of the copper float locality and about 4 miles east of the Aremu shaft. The hill is covered with distinctive laterite clays although sheared amphibolites outcrop at the crest.

Soil sampling showed anomalous nickel and copper values following the trend of the hill. In two pits nickel shows increase up to 2,000 ppm. at the bottom.

- d) An east-west trending copper-zinc anomaly is developing from continuing surveys about 4 1/2 miles ENE of the Aremu Mine. This anomaly partially overlaps an airborne EM anomaly of 3 1/2 miles strike length. The anomalous zone can be traced as secondary dispersion train for roughly 7,000 feet following the swampy alluvial flats of the Baramalli Creek. The coverage is insufficient at present to define the anomaly fully and further work is in progress.

Peter's Mine

Peter's Mine is one of the New subsurface mining ventures in the history of British Guiana mining. Surface working commenced on an auriferous quartz vein report as 30 ft. in width and averaging 1 oz/ton. Subsurface production commenced in 1904 but operations closed in 1909 after 40,000 oz. of gold has been produced.

Although covered by airborne EM surveys no anomaly was recorded in the immediate mine area. No drilling has been undertaken during the operation and although some records are available they present only a partial picture. It was quite clear however that the mine locality presented a drilling target and a programme was carried out during 1965 under the direction of Mr. C.N. Barron and advice from Mr. J.R. MacDonald.

5309 ft. of drilling was accomplished in 7 holes. These were designed to test the ground below the old workings, check for lateral extension of the one zone, and throw additional light on geology and structure of the region which was very poorly known. All these purposes were accomplished and the mine now stands in a much improved position for the possibility of reopening. At the same time vigorous surface work was undertaken by Mr. C.N. Barron supported by Field Observer, S. Narain and Assistants S. Jagai and V.A. Agrippa.

Holes No. 1 and No. 2 tested beneath the old workings and intersected the main Peter's Mine Vein at about the 450 foot level. Hole No. 1 met visible gold, assay results indicating about 1 ounce per short ton over 4.6 feet after cutting. Holes No. 3 and No. 4 similarly tested the northern positions of the lodes: both holes showed traces of visible gold but assay results are not so encouraging as in No. 2. Holes No. 5 and No. 6 crossed the strike of the veins several hundred feet north of the mine: the veins were in fact encountered but were reduced in size and carried no visible gold. Assay results have not yet been received from M.R.D.

The final hole, No. 7, was drilled to the southwest of the mine to determine the cause of a marked ground-magnetic high. This turned out to be due to some 600 feet of adesitic lavas. The hole was continued so as to intersect the strike of one of the main ore bodies, but these assay results have also not been received at time of writing.

Geophysical Surveys at Kutuau and Waiamu

In ground follow-up to airborne E.M. response Mr. G.N. Rodwell undertook ground geophysical surveys in the Kutuau and Waiamu areas.

United Nations Turam equipment was utilised. In this system an alternating current is supplied to an insulated line or loop in the area of interest. The magnetic field set up by the current induces ground currents which in turn modifies the magnetic field at the surface.

The orientations used at Kutuau and Waiamu involved a long primary cable earthed at both ends arranged parallel to the expected strike of the conductor. The field components are detected by two coils aligned perpendicularly to the primary cable, observations being undertaken at increasing distances from it up to a maximum of about 2000 feet. The parameters measured are phase differences, reduced ratios and field inclinations.

In the Kutuau area the results indicated.

- i) A series of an echelon steeply dipping, near-surface conductive zones. The interpretation suggests depth to the top of the conductor ranging between 25 and 50 feet.
- ii) An area of several elongate near-surface conductive zones striking sub-parallel to the Guyuni River.

It is considered that the airborne E.M. anomaly of the Kutuau region was successfully located by the Turam equipment. Graphitic material is the most probable cause of the response. The outcrop of graphitic zones in the vicinity supports this view.

A total of 54,975 ft. of line was surveyed during the work, excluding overlaps.

At Waiamu, the area to the north of Waiamu island and adjacent to the Guyuni River was surveyed in order to track down the precise locality of an airborne response.

Four major extensive elongate conductive zones were encountered during 42,000 feet of traversing. Conductor A with rather weak conductivity over 2,500 feet, is apparently thin with its top about 100 feet below the surface. Conductor B is the manifestation of a near surface conductive zone, continuous throughout the surveyed area with a minimum length of 5000 ft. It is apparently rather variable in conductivity, conductivity ranging from good to parallelism but marked variations in response.

Again, graphitic zones are the surmised cause.

Area 33

Airborne E.M. becoming available towards the end of 1964 indicated the occurrence of a conductor of possible importance about 5 miles northwest of Peter's Mine. Mr. C.N. Barron, in charge of the Peter's Mine surveys was advised to undertake preliminary reconnaissance.

Two small copper-nickel anomalies were encountered by reconnaissance geochemistry but ascribed to lithologic causes. As described (p. 47) geophysical work located the source of the airborne anomaly which was subsequently drilled with four short diamond drill holes. Surface exposures showed carbonaceous mudstones associated with coarse amphibolite, a sequence confirmed in the drilling.

The carbonaceous zones are clearly the cause of the airborne response and in the absence of encouragement from geochemistry this immediate locality is now discounted.

Kutuau-Waiamu

Geological observations carried out by Dr. S. Singh added to previous work in this district which is formed basically of a thick sequence of metamorphosed greywacke sediments intercalated with volcanic rocks, all folded and intruded by granite stocks and dolerite dykes. Graphitic and manganiferous horizons occur, the former being of possible economic interest in the future.

Although it became clear that airborne response was of formational origin geochemical sampling gave some suggestion that a Ni/Co anomaly may be present and appears to warrant further follow-up.

Geophysical Expedition to Groete Creek

Mr. G.M. Rodwell undertook geophysical observations in the Groete Creek from 18.6.65 to 26.7.65. Although this entailed Mr. Rodwell working in the wet season under some difficulty and after hard first season field programme, the interest of the locality demanded prompt attention. The area covered, was a block some 2000 feet wide and 4,500 feet long over a geochemical soil copper anomaly defined during the first field season.

The results showed a weakly conductive zone showing good coincidence with the axis of the main geochemical anomaly and some responses over certain of the outlying geochemical 'high'. Interpretation suggests a vertical or sub-vertical thin conductor apparently connected with the Cu/Ni geochemical anomaly.

Self-potential surveys gave results of no recognisable significance. Magnetometer surveys suggest that the source of the geochemical and ground electromagnetic anomalies is deficient in ferromagnetic minerals, and if there is indeed mineralisation present, the host rock is relatively non-magnetic.

Geophysical Work at Area 33, Puruni

Mr. G.M. Rodwell carried out Turam E.M. Surveys in the so called Area 33 during first and second field season of 1965. The work was undertaken to track down an airborne EM anomaly indicated by the United Nations airborne programme. The source of the anomaly was successfully located.

Some 42,000 ft. of traversing was undertaken. Three elongated shallow, parallel conductors were indicated shallow, parallel conductors were indicated having nearly east-west strikes and steep dips.

Associated self-potential surveys established two large parallel negative trends almost coincident with two of the three conductors.

Geochemical search for copper and zinc in the area showed no significant anomalies.

Mr. S. Narain, Field Observer, carried out a magnetometer survey over the region which displayed several small closed isolated magnetic 'highs', sometimes with associated 'lows'. The nature of these anomalies does not suggest any economic significance. A small anomaly contiguous with a quartz vein was also shown.

Drilling encountered graphitic horizons which are undoubtedly the source of the E.M. anomalies.

Mariwa

With the cooperation of the Demerara Bauxite Company an investigation was carried out by Mr. J.H. Bateson upon the distribution of selected elements in a laterite profile exposed at Demba's laterite quarry at Mariwa. Although geochemical prospecting has been shown as of critical importance in mineral exploration in the country there is still little orientation data available which

would assist in the critical evaluation of the geochemical anomalies.

Laboratory investigation of channel samples produced the following results.

A chemical continuity was observed from bedrock to the surface in which silica is reduced to about 1/7th of the bedrock content, with a 3-fold increase of iron and aluminium oxides. The section demonstrates the leaching processes that remove SiO_2 from the system and which also has a tendency to mobilise the Fe_2O_3 and transport it downwards and redeposit it roughly with the level of water saturation.

Analyses were carried out for nine miner constituents Co, Ni, Mo, Cu, Pb, Cr, Ti, and Mn.

From these limited studies it would appear that under the conditions that prevail at Mariwa Zn and Cr both survive and accumulate in the laterite zone. Copper also tends to remain in the laterite more or less in a state of equilibrium with the present material. No lead or molybdenum was detected. There was some evidence of nickel and cobalt concentrating at the base of the profile, although values were low and in the case of nickel, considerably less than would be anticipated in the bedrock dolerite.

V. Research Projects

a) Palaeomagnetic Studies

During 1964 Professor R.B. Hargraves of Princeton University indicated his interest in undertaking palaeomagnetic work on the gabbro sills in the Roraima Formation. His interest has been aroused by the age determination programmes which have recently been carried out on these rocks and which have shown them to be very much older (Lower Proterozoic) than anyone has previously envisaged.

In brief, palaeomagnetic work is aimed at determination of the direction and polarity of the earth's magnetic field at the time of formation of the rocks on which measurements are made. As a result, evidence can be obtained on the disposition of the continents and oceans and of the position of the magnetic poles at various times throughout geologic history.

Professor Hargraves visited the country twice during the year and the Geological Survey was pleased to be able to give some assistance to his programme. A brief expedition was mounted to the Kamarang-Kako region from 9th-16th January. Oriented samples were taken by Professor Hargraves, at Kowaitipu, Konaitipu above the Paruima at Ituwubishi Fall and at exposures above Kamarang Mouth. Following the Kamarang work, sample collection was continued on the eastern side of Eboropu Mountain, on this occasion approached by an old Geological Survey trail from the Chinakuruk Creek, a tributary of the Kako River.

After his visit to British Guiana, Professor Hargraves flew to Venezuela where he was given similar cooperation from the Ministerio de Minas e Hidrocarburos. This enabled material to be obtained from Escalera to Cano Negro and to Sta. Eldna.

Study of the samples led to the conclusion that there may be two separate ages of intrusion of dolerites in the Roraima, the Chinakuruk group giving distinctly different results to those from the Kamarang. This is of great interest and resulted in a return visit by Professor Hargraves in October when sampling was undertaken at Tumatumari, Kaitear, Tukeit-Kangaruma, Eagle Mountain and Velgrad.

The publication of Professor Hargraves' work is awaited with great interest.

b) Palynological Research Project

The Geological Survey has been acting as coordinating agency for a pollen research scheme financed jointly by bauxite companies in British Guiana and Surinam. The companies concerned are Reynolds Metals Ltd., and the Demerara Bauxite Company in British Guiana at the Billion Maatschappij and Surinam Aluminium Co. of Surinam. The project is now approaching conclusion.

During the course of the scheme Mr. T.A. Wijmstra has visited the country and Surinam. The various contribution companies have provided samples for palynological analysis together with appropriate data, and the results of studies of Professor Th. van der Hammen for the Geological Survey of British Guiana itself have been made available to the project.

The results of the programme remain confidential until the contributing companies have had opportunity to study them fully. However it was agreed that the data will be published as soon as practicable and there is no doubt that it will represent a highly important contribution to the literature on the stratigraphy of the Guiana coastal sediments.

VI. Mineral Development

BAUXITE

Demerara Bauxite Company

Shipment of calcined bauxite by the Demerara Bauxite Company Ltd. reached a record figure of 485,000 long tons. In addition, the Company processed and shipped from its Mackenzie plants 275,000 tons of alumina and 880,000 tons of dried metallurgical grade bauxite.

Calcined bauxite went forward to manufacturers of abrasives and refractories in 30 countries. During the year 308 vessels lifted cargoes with a sales value of \$62 million from Mackenzie.

During 1965 Demba commissioned a \$3 million tailings recovery plant to recover additional quantities of usable bauxite from high silica material removed in the washing plant. The plant has a capacity of 300,000 tons annually.

A further major addition was the installation of a plant to produce synthetic mullite from which test quantities were produced.

A third bucket wheel excavation system for the removal of overburdens was commissioned in mid-year. The system, which includes conveyors for moving the overburden out of the mining area, cost \$4,000,000.

A new evaporation unit was installed in the alumina plant to remove impurities from process liquor.

Recently, the company announced a \$38 million investment programme for 1966/67. Additional stripping equipment amounting to \$15 1/2 million and including two large bucket wheel excavators and a walking dragline are to be acquired. Capacity of these three machines is to be 15 million tons a year. An additional calcining kiln, Demba's seventh, is to be installed raising the company's annual capacity for calcined products to 700,000 tons. The cost of this installation and related facilities is estimated to be \$5 1/2 million.

The railway and vehicle bridge across the Demerara is now under construction and will enable the company to open up a new mining area on the West Bank.

In the exploration field an experimental programme to evaluate the suitability of seismic methods was introduced with satisfactory results. This technique is now being introduced into regular exploration programmes. In order to step up pace of exploration additional drilling equipment has been acquired. Surface exploration ceased as such, in areas covered by exclusive permission and was replaced by drilling activities.

In October a long term agreement was signed between the Company and the B.G. Government.

Reynolds Metals Company

This company shipped during 1965 a total of 376,389 long dry tons compared with 305,603 long dry tons for 1964. Shipments of chemical grade ore increased proportionately more than of metallurgical grade ore. The installation of a new dryer resulted in a sharp increase in production beginning September and at year end the production rate was equivalent to 600,000 tons per year, a rate which the Company expects to maintain during 1966.

Early in 1965 a long term agreement was signed between the Company and the British Government and the Company commenced implementation of a \$4 1/2 million expansion programme which is expected to be completed early in 1966.

In September of 1965 a severe subsidence of the Company's stockpile at Everton resulted in the loss of 20,000 tons of ore and damage to building structures and transportation facilities. At year end the Company announced their intention to build a plant at Everton to produce calcined bauxite for the refractory and abrasive industry. The cost of this plant with additional supporting facilities is estimated at \$6 million and construction is expected to commence early in 1966.

The U.S.A.I.D. feasibility survey of the Berbice Bar is expected to be completed early in 1966 and favourable results are anticipated.

MANGANESE

Manganese Mines Management, a subsidiary of Union Carbide, produced during 1965 at their Matthew's Ridge operations a total of 166,194 wet tons of manganese are compared with 116,881 wet tons for the previous year.

During the second half of the year exploration drilling was carried out on the Company's Pipiani concession in the Barama River.

DIAMONDS

During 1965 a total of 112, 874 carats of diamonds were produced an increase of approximately 4 % over the 1964 production.

Suction dredges continue to increase in numbers and 65 % of the 1965 diamond production came from dredges.

GOLD

Of the 2077 ounces of gold won during 1965, 893 ounces came from the North West District. Though there was a 1 % decrease in the colony production compared with 1964, this presents a more stable picture when compared with a 25 % decrease for the 1964 production compared with that for 1963.

Gold winning operations were mainly small scale and almost exclusively alluvial.

OILCoastal and offshore belt

The year 1965 saw a positive step in the investigation of the oil and gas potentials of the country. Guyana Shell Ltd. was granted an Oil Exploration Licence covering 9,600 square miles of on-shore and off-shore area in the north-east of the colony.

A crew of western Geophysical was contracted by Guyana Shell Ltd. to carry out a reconnaissance seismic programme. The programme which consisted of 2038 km. of line was commenced in August and completed in September. At the end of the year the results were still being processed.

The Continental Oil Company of British Guiana was granted an Oil Exploration Licence over 13,800 square miles of off-shore area in the north western sector of the country immediately adjacent to and west of the concession granted to the Guyana Shell Ltd. A seismic reconnaissance programme under contract to Western Geophysical was carried out but at year end the results were not available.

VII. Headquarters

Drawing Office

Pressure upon the Drawing Office increased during the year owing to the requirements of the United Nations-British Guiana Aerial Geophysical Survey reaching its concluding stages. Throughout the period of the project a considerable amount of additional work has developed upon the Drawing Office including the provision of special Darkroom and other services. Increasing calls for work from the Mines Division, much of which has previously been undertaken by the Cartographic Section, Lands and Mines Department.

Staff shortages made themselves increasingly felt and unless rapidly corrected will have a seriously adverse effect upon work output and standards during the forthcoming year when commitments will increase materially. Readjustments in staffing a structure in order to provide for more effective handling of responsibilities acquired from the Mines Division have been recommended.

During the year the normal work of the Drawing Office in preparation of Geological Maps, sections, drill logs, diagrams etc. were prepared. Maps and diagrams for inclusion in the Records of the Geological Survey Volumes II and III and for Bulletin 36 were redrafted for publication.

In addition special work was undertaken for papers presented to the IVth Caribbean Geological Conference in Trinidad; the report on the Mineral potential of British Guiana by the United Nations specialist, Mr. J.R. MacDonald, this involving a particularly large number of maps and diagrams; and illustrations for a renewed application for support from the United Nations Special Fund.

On request special model maps were prepared for the Ministry of Trade and Industry for their display at the Trade Fair in Surinam, for the Geological Conference in Trinidad and for the Ministry of Economic Affairs.

The high standards attained in the Geological Survey Drawing Office lead to numerous requests for draughting work which the Department endeavours to fulfil if it can properly do so. In particular assistance continues to the Soil Survey branch of the Agricultural Department.

During the year a total of 6,390 dyeline prints were made, using 24,625 square feet of paper. The fact that some 50% of these prints required some degree of hand colouring will give impression of the very large amount of work entailed.

The section is particularly to be congratulated at the manner in which it has sustained the increasing pressure.

Laboratory

Over the past few years the emphasis of work of the Geological Survey Laboratory has undergone radical change. Earlier oriented primarily for the needs of regional reconnaissance mapping and certain special analytical programmes it is now devoted largely to analyses for geochemical surveys. These surveys entail examination of a very large number of samples and the

laboratory is still in process of reorganisation for efficient handling of the large volume of work.

New equipment, including the large Quartz Spectrography provided by the United Nations Special Fund and the only instrument of this type of this size in the country has immensely increased output of determinations.

The performance of the laboratory has been remarkable, particularly when it is remembered that there has been no fully professionally qualified officer in charge of the section since the departure of Dr. Harden in February 1964 this performance may be judged by comparison of the number of geochemical determinations completed in successive years:

1963	19,580
1964	23,226
1965	69,252

Library

No progress was made in alleviating the space problem in the Library. The stock of books at the end of 1965 was 11,340 an increase by 781 over the previous year's holdings. During the year the Library received 70 different periodicals of which 37 were subscribed for and 33 free or on an exchange basis. 62 of these periodicals are scientific and technical while 8 are of administrative, commercial or general interest.

The Library maintained a wide distribution of the Department's publications to 203 Universities, Libraries, Geological Surveys and other institutions and individuals. The publications of many of these institutions were received in exchange. A total of 1,387 publications were issued, 612 on sale and 775 free.

Publications

Publications printed, or obtained for sale or free distribution were as follows:-

- | | | |
|----|---|------------|
| 1. | Report on the Geological Survey Department for the year 1963. | 452 copies |
| 2. | Bulletin No. 36. Reports on prospecting for oil in British Guiana, by S.N. Simakov and V.V. Fedynsky. | 744 copies |
| 3. | Records of the Geological Survey of British Guiana. Vol. 2 | 750 copies |
| 4. | Records of the Geological Survey of British Guiana. Vol. 3. | 759 copies |
| 5. | A palynological study of Tertiary and Upper Cretaceous of British Guiana, by T. van der Hammen and T.A. Wilmstra. <u>Leid. Geol. Meded. dl. 30, 1964.</u> | 350 copies |

LIST OF PUBLISHED REPORTS - 1965

- Records, Vol. 2
 Records, Vol. 3
 Bateson, J.H. Geochemical breakthrough in mineral prospecting in British, Guiana, *Canad. Min. J.*, vol. 86, No. 12, Dec. 1965, pp. 71-73 and 78.

Staff Availability during 1965

Name	Designation	Period of duty	Remarks
P.H.A. Martin-Kaye	Director	1.1.65-10.8.65 13.12.65-31.12.65	On leave from 11.8.65 to 12.12.65.
P.B.H. Bailey	Deputy Director	1.1.65-31.12.65	Acted Director from 11.8.65 to 12.12.65
Sobharam Singh	Senior Geologist	1.1.65-31.12.65	Acted Deputy Director from 11.8.65-12.12.65
C.N. Barron	Senior Geologist	1.1.65-29.9.65 1.11.65-31.12.65	On training Course in Canada 25.9.65-31.10.65
J.H. Bateson	Senior Geologist	1.1.65-31.8.65	Accepted Appoint- ment with Over- seas Geological Survey with effect from 1.9.65
G.N. Rodwell	Geophysicist	1.1.65-31.12.65	
E.R. Biggs	Geologist	1.1.65-30.1.65	Contract ex- pired 30.1.65
G.A. Sampson	Geologist	1.1.65-31.12.65	
C.D.G. Black	Geologist	1.1.65-24.3.65	Contract ex- pired 24.3.65
R.H. Hewins	Geologist	1.1.65-14.2.65	Contract ex- pired 12.2.65
J.D. Punwasee	Geologist	4.12.65-31.12.65	
H.O. Bruggmann	Geologist	30.12.65-31.12.65	
T.M. Rahaman	Chief Draughts- man	1.1.65-31.12.65	
O. St. John	Scientific Assistant	1.1.65-25.1.66	Retired from the Public Service
M.A.A. Shariff	- do -	1.1.65-31.12.65	

Name	Designation	Period of duty	Remarks
V.H. Campbell	Chief Clerk	1.1.65-9.5.65	Appointed to act S.P.O. Min. of F.L. & M. with effect from 10.5.65
S. Singh	Chief Clerk (Ag.,)	10.5.65-31.12.65	
Miss R.E. Harry	Supervisor of Library & Records	1.1.65-13.6.65 9.12.65-31.12.65	On leave from 14.6.65 to 8.12.65
Miss M.I. Wren	Supervisor of Library & Records (Ag.,)	14.6.65-8.12.65	