GEOLOGICAL SURVEY DEPARTMENT

Ministry of Agriculture and Natural Resources

ANNUAL REPORT 1969

P.O. Box 789,
Georgetown, Demerara,
GUYANA.

GEOLOGICAL SURVEY DEPARTMENT

ANNUAL REPORT FOR 1969

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

I. INTRODUCTION

The Geological Survey Department has its Headquarters in Georgetown. A district office is also maintained at Bartica, which is situated at the confluence of the Essequibo and Mazaruni Rivers, a focal point for access to the interior and about 50 miles from Georgetown.

At the Headquarters in Georgetown are housed the Administrative and Geologists' offices, Petrological, Geophysics, Spectrographic, Colorimetric, Atomic Absorption, Fire Assay, Sample Preparation and Lapidary Laboratories; a Wireless and Geophysical Workshop; a Cartographic Office, Library and a Museum. Other facilities include a Rock Store, Mechanical Workshop and Stores. The District Office at Bartica continued to function as an intransit centre for stores and personnel between Headquarters and field operations. The Department's boat house is located at Bartica nd this housed the Department's fleet of 25 bateaux during the off field season periods of the year.

The function of the Geological Survey is to establish the nature and extent of the country's geology and mineral resources as far as possible and necessary for Government purposes and to undertake, or advise Government on any other projects in the public interest which have geological implications.

During the year the Department fell within the responsibility of the Ministry of Agriculture and Natural Resources.

II. GENERAL REVIEW OF THE YEAR

Professional Staffing:

A 45% staffing level was maintained during the first field season of the year and this rose slightly to 50% by year end. Dr. H. Schielly left on 19th August on the termination of his contract. Mr. J.C. Inasi successfully completed his course of training at London University and was appointed as a geologist with effect from 5th August. Mr. N.R. Cameron was seconded from the Ministry of Housing in Great Britain for a two year period to fill a vacant post of geologist in this Department with effect from 7th August.

At year end there were only 6 Guyanese Geologists in the total establishment of 20. The Department continued to rely heavily on expatriate recruits who only accept short term contracts.

An availability of the senior professional staff during the year is given in Appendix I.

Other Staff:

Miss J. Singh, Temporary Clerk attached to the Library was appointed Administrative Cadet in the Secretariat of the Public and Police Service Commission. She was posted to the Public Service Ministry from 8th September, 1969. Mrs. J. Bannister assumed duties in the Library on 14th July, 1969 as Acting Supervisor of Library and Records. Miss G. Jordan assumed duties as Secretary on 19th February, 1969 vice Mrs. V. Wharton transferred to the Inland Revenue Department.

Training:

Mr. G.A. Sampson, Senior Geologist, continued his course of training leading to the M.Sc. degree in Petrology and Mineralogy at the University of Toronto under the Commonwealth Fellowship Plan. Mr. R. Henry, Field Observer continued his course in Geochemical Prospecting in West Germany. Mr. B.L. Sucre, Field Assistant trainee left Guyana in September to take up a Canadian Government award at the University of Manitoba, Canada, for a 4-year course of training leading to the B.Sc. (Hons.) Degree in Geology. Mr. C.G. Rodrigues continued his studies for the B.Sc. (Hons.) Degree at the University of British Columbia under a Canadian Government Award. Mr. Sat Narain, Field Observer was awarded a six month Fellowship in Alluvial Minerals Technology at the George Washington University, U.S.A. under the sponsorship of the United Nations. He left Guyana on 1st September.

III. SUMMARY OF FIELD WORK

A. GEOCHEMICAL-GEOLOGICAL EXPLORATION

1. Tupuru and Whitewater Creeks, lower Cuyuni River: a geological and stream sediment reconnaissance by J.D.N. Punwasee, First Season, 1969.

Tupuru and Whitewater Creeks are old alluvial gold prospects lying about a day's journey up the Cuyuni River from Bartica. They appear to lie along strike from the Groete Creek gold-copper prospect, some 15 miles to the east, and this reconnaissance was primarily intended to look for evidence of base metal mineralisation especially copper, in the two creeks.

Both streams are underlain by greenstones intruded by granodiorite, but there is an extensive cover of white and brown sands, particularly in the Tupuru basin. The more basic rocks project through these sands as hills and ridges, especially in the Whitewater area, and are often capped by laterite duricrust. Both the laterite and the sand cover serve to obscure much of the geology and make the geochemical sampling and interpretation more difficult. For the same reason, the structural picture is very incomplete, though a north-northwest foliation strike, with south dips of 35-80°, is general in the Whitewater area.

The sediment samples were tested for Cu, Zn and Mo colorimetrically, and scanned for Cr, Co, Ni and Pb on the spectrograph. Two well-marked lens-shaped zones of anomalous Ni, Cr and Zn have been outlined on the R.B. tributaries of Tupuru Creek, over metadiorite. Sediment metal values in these zones reach 400 ppm Ni, 250 ppm Cu and 600 ppm Cr on backgrounds of 20-30 ppm. Copper values in the Whitewater basin vary between 50 and 170 ppm and are not considered anomalous. Colorimetric analysis for copper in the Tupuru area are not yet complete.

2. Demerara River: West bank above Great Falls. Geochemical survey by A.K. Banerjee, First Season, 1969.

Airborne "Input" E-M anomaly 157 near the west bank of the Demerara River was covered with a 3 square mile soil sampling grid at 1000 x (100' - 200') centres. The highest values reached were 100 ppm copper and 80 ppm nickel and zinc. Background was 20 ppm copper over swamp and sand, and 70 ppm over amphibolite and laterite.

Air photographs indicate that the airborne E-M anomaly coincides with an old river channel, which experience in Nigeria and elsewhere indicates could be the source of the conductor.

3. Mariwa Mountain and Sardine Hill area, Lower Cuyuni River: Geological and Geochemical Surveys by C.N. Barron, First Season, 1969.

During several short visits totalling about 5 weeks, a geochemical soil grid was sampled on the western flanks of Mariwa Mountain, and a stream reconniassance undertaken in the Mariwa River - Sardine Hill area.

On the western slope of Mariwa Mountain, conformable soil copper anomalies reach 560 ppm on a background of 100 ppm. Incomplete stream sampling suggests that this N-S copper-rich belt extends over North Mariwa Mountain as well. Mariwa Mountain was the site of a small Dutch copper mine in 1741.

Sardine Hill, situated some 4 miles further east is an old eluvial goldfield which may be related to a N-S fault postulated to run along the Mariwa valley. White Sand Formation cover prevents satisfactory soil surveys, but stream sediment analyses indicate high copper (300 ppm) on a background of about 50 ppm. Aero E-M surveys by both U.N. and Sherritt Gordon showed conductors of some interest on Timmerman Hill, immediately east of Sardine Hill. However, stream sediment analysss showed no Co, Cr, Cu, Mo, Ni, Pb and Zn anomalies possibly due to the increasing thickness of the sand overburden.

Dr. A. Choudhuri, Government Petrologist, spent 3 weeks in the Mariwa-Waikuri area, and made a preliminary examination of the rocks.

The Sardine Hill area is recommended for further investigations by means of geophysics and also by soil geochemistry, using an auger, or shallow drill holes to penetrate the overburden.

4. Hills south of Ianna Goldfield: Geological and geochemical reconnaissance by J. Inasi - Second Season, 1969.

A small goldfield was encountered by A.R. Westerman during examination of a 2-channel airborne E-M anomaly some 4 miles south of Ianna Mouth, Barama River. As follow up, geological, geochemical and alluvial mineral surveys were made of the streams over an area of some 5 square miles, west of Ianna River.

The rocks in the area include meta-andesites and hornblende schists, together with dominantly psammitic metasediments such as quartzite, quartz-mica schist and quartz-kyanite schist. The regional strike of foliation and rock types is ESE, with northerly dips usually exceeding 60°. Two bodies of similar biotite granite intrude the area in the south and west, and are associated with tourmaline-quartz veins and possibly with the development of kyanite.

Spectrographic analyses of stream sediment for Cu, Cr, Mo and Pb, Co, Ni shows Mo and Pb below 3 and 7 ppm throughout. Sediment copper increased from a background of 15 ppm to 70 ppm on approaching the granite along western tributaries of Labaria Creek. The Cr background is about 70 ppm, but high values reaching

400 ppm occur in the Campbell Creek area where the rocks are extensively sericitised and carries quartz veins.

Alluvial gold is also confined to the southwest, where it rises towards the granite margin to reach 50 "eyes" per batel. At the same time it becomes coarser. Some old prospect pits were seem here, but no old workings. Two varieties of vein quartz - blue and white - occur in the area: from evidence in Ianna Goldfield, the gold may be associated with the blue variety, but there is no evidence for this here.

This could be an interesting prospect for the small miner.

5. Long Mountain-Sand Creek Area, Groete Creek Goldfield: a geological and geochemical survey by M.C. Hamilton and N.R. Cameron, Second Season 1969.

The object of this survey was to trace the Groete Creek (Black Creek) gold-copper mineralisation westward along the strike to the small Sand Creek goldfield and the northern end of Long Mountain. To this end, an area some 3000' wide and 7500' from east to west was soil sampled at 100 x 500' intervals and sediments were collected from streams crossed. A subsidiary grid was also sampled east of the main area, to complete its link up with the Black Creek gold-copper prospect drilled in 1968/9. This lies north of the grid sampled during the first season 1969.

The geological formation consists of quartzites in a sequence of weathered metacolcanios with a phyllitic appearance. The phyllite-like rocks are deeply weathered, but carry fine grained albite with sericite and chlorite. On present evidence, the particular horizons in which copper minerals were found in the Black Creek area appear to be absent here.

Colorimetric assays on 1377 soil and stream sediment samples of the grid revealed two weak, not too clearly defined soil copper anomalies panning out in a northwesterly and in an east-northeasterly direction, from the northern peak of Long Mountain. The areas over the Black Creek Granite and the adjacent White Sand area are characterised by the prevalence of background soil copper values of ca. 20-40 ppm., while the lateritic soils and duricrusts over Long Mt. give rise to a slightly higher background values of 40-80 ppm. The anomalies are vaguely defined by 100 ppm contours enclosing stronger 200 ppm closures. Three isolated peak values of 300-400 ppm Cu occur.

The trend of the anomalies correspond more or less with major structural directions viz. (a) frequently occurring NW striking quartz-pegmatite veins in the Black Creek Granite and (b) an ENE striking shear zone. From topographical and drainage considerations, however, the ENE trending anomaly seems to be hydromorphically associated with a deeply incised creek valley along which intense erosion of the lateritic soil and duricrust of Long Mt. has exposed fresh amphibolites and hornblende-schists. Since the 200 ppm Cu recorded over this locality is only slightly higher than the accepted minor element content for copper in mafic igneous rocks (140 ppm - Hawkes and Webb 1965), the anomaly could just as well be interpreted as an expression of the contrast between soil cover and the minor copper content in the bedrock. Of further interest in this respect is the occurrence of minor sporadic disseminations of iron and copper sulphides in some specimens of amphibolites and hornblende schists from this area.

On the other hand, the NW lying anomaly, although occurring partly over a N-S running creek, acquires an ovate shape with its long axis parallel to the trend of regional foliation and thus assumes greater significance as a marker for possible underlying mineralisation.

A cursory examination of the White Creek gorge southwest and south of Long Mountain has shown the presence of an extensive series of metasediments south of the Black Creek-Sand Creek belt. In view of the extensive alluvial gold workings in the stream, and the evidence of later tectonic events, further work is planned in this area.

6. Monkey Creek and Falls Creek Goldfields, Puruni River.
Geological reconnaissance and stream prospection by M. Milner, 3 weeks of Second Season 1969.

The Falls Creek goldfield lies some 11 miles west of Peter's Mine, and until this visit has not been visited by a geologist. The alluvial gold coincides with a granite-sediment contact and the richest deposits appear to derive from an area of about 1 square mile, on which eluvial gold has already been found. There is little evidence of structure in the area, but distribution of rock types suggests an E-W trend.

The small Monkey Creek goldfield lies further north, near the Puruni River, and was examined very briefly en route to Falls Creek head.

Congrove Hill is a prominent gabbro ridge immediately north of Falls Creek goldfield, and consists of gabbro. Falls Creek itself appears to be identical with Waimparu Creek, which enters the Puruni $1\frac{3}{4}$ miles below Peters Mine Landing.

Further work is planned in this area, both to locate the source of the Falls Creek gold more precisely, and to prospect the area eastwards towards Peters Mine.

7. Ichaura Hills Goldfield, Potaro and Kuringrong-Rivers. Geochemical and geological reconnaissance for base metals by A.K. Gibbs, Second Season 1969.

The coincidence of a 2 channel Airborne E-M anomaly over 4 traverses with an area of old gold workings led to a three-week programme of stream sediment sampling and associated geological work.

The upper-part of the hills is covered with laterite duricrust which effectively hides the solid geology and distorts the geochemical signals. Elsewhere the rocks are mainly intermediate to acid flows and pyroclastics, including agglomerates, with apparently irregular areas of red-brown ferruginous cherts. Quartz veins up to 10' wide intrude these rocks and locally carry pyrite and chalcopyrite and show some molybdenum in assay. The volcanics appear to overlie a medium grained weakly foliated granodiorite, often carrying phenocrysts of quartz and occasionally feldspar and chlorite and often hornblende. No sharp contact was seen though small granodiorite dikes intrude the volcanics, which may be comagmatic with it. The volcanics and to a lesser extent the granodiorite show propylitisation and quartz-pyrite filled features.

The sediments were spectrographically scanned for Cu, Ni, Mo, Pb, Cr and Co. High copper values up to 400 ppm closely coincide with streams draining duricrust. This effect is much less

pronounced with the other elements; none of these define well marked anomalous areas, however, except molybdenum which shows a well defined group of 30 ppm in the south of the area near the most northerly exposures of granodiorite. Colorimetric assay for copper and molybdenum is planned, as well as a closer examination of the molybdenum-rich area.

8. Waikuri Area, South of Cuyuni River: geological and geochemical surveys by A.K. Banerjee, Second Season 1969.

The many aero E-M ("Input") anomalies south of this part of the Cuyuni River were examined with the assistance of stream sediment sampling over an area of 40 square miles together with soil sampling over selected areas totalling about 8 square miles.

Geologically the area is underlain by roughly E-W striking acid to intermediate volcanics and interbanded tuffaceous sediments: the latter are more abundant in the south, and are locally carbonaceous. The rocks are metamorphosed in the greenschist facies and the weathered sediments are commonly phyllitic in appearance, with interbedded white to red-brown quartzites. A cherty rock, locally banded, may be a vitric tuff. Other volcanics vary from andesite to rhyodacite, and are locally vesicular, porphyritic or flow banded. Later complementary "shear zones" trending ENE and ESE are associated with foliation and quartz stringers. Massive barren quartz veins are abundant near the contracts of two major sedimentary and volcanic bands in the south, and there are also alluvial gold workings here. Apparent repetition of rock units, and reversal of the normal subvertical dips suggests

that there may be close folding, but this was not directly evident.

Streams were sampled at 1000' intervals and analysed for copper, nickel and zinc. Background and highest values were 20/160, 30/220 and 30/200 respectively. Copper and nickel tended to vary together, and persistently exceeded 100 ppm in two areas on either side of Waikuri Creek. These areas included old gold workings, and together with another area to the south were soil sampled on centres of 200 x 500 - 1500 feet. Soil copper background was 10 ppm and several "possibly anomalous" patches with over 60 ppm were defined within two metasedimentary bands. Background and highest values for the three metals, Cu, Ni and Zn are 10/120, 60/200, and 80/220 ppm respectively. The best soil zone carries some limonitic gossan, and one sample of this showed 2000 ppm Cu, 2000 ppm Ni and 1500 ppm zinc.

Although these values do not suggest significant mineralisation, and all or most of the AEM anomalies may be atiributed to carbonaceous sediments yet the persistence of gold mineralisation and anomalies south of the area suggests that further work in that direction can be justified.

9. Baramalli Sampling in Base Metals Exploration: a promising new geochemical technique introduced by A.K. Gibbs, Second Season 1969.

The White Sand Formation covers much of the possibly mineralised ground of western Guyana. This prohibits normal geochemical sampling. The development of a technique of biogeochemical sampling may partially alleviate this problem.

The Baramalli tree is common in areas with a White Sand soil and it has a large deep taproot. Augered heartwood samples from Baramalli trees in the Tamour, Barabara, and Groete Creek areas have been spectrographically analysed for trace elements. Readily detectable amounts of Co, Ni, Pb, Mo, Cr, and Cu were found. At Groete Creek the samples were taken both over residual soils and White Sand soils with known trace metal concentrations. Copper and molybdenum anomalies of 5 to 10 times background were found, corresponding to known soil anomalies. In addition, the mineralised zone was shown to continue under the White Sand cover. Data from the other areas awaits further reduction.

There are certain obvious limitations and difficulties in applying and interpreting this technique, notably the thickness of sand, and the presence of sedimentary clays beneath it, as well as preferential accumulation of certain metals by the tree. The usual problems of metal dispersion will also be present. Nevertheless, it promises to be an exploration tool of increasing usefullness as its limitations are understood and allowed for.

B. GEOPHYSICAL - GEOLOGICAL EXPLORATION

1. Lower Kartuni River area: geophysical and geochemical follow-up of A.E.M. anomalies by S.N. Saha, U.N. Geophysicist, Feb.-May, Sept.-Oct., 1969.

Nine airborne ("Input") E.M. anomalies in area E-13 were examined using ground geophysics (E-M, S-P, gravity, magnetics and scintillometer) and soil geochemistry. All except Nos. 41, 85

and 89 had already been geologically and geochemically reconnitred by H. Schielly in 1968. The principal rock types in each area are slightly metamorphosed andesites, sediments and occasional basic intrusives.

Conductor 32 could not be located by the ground survey which showed only small conductors associated with known faults, and without other geophysical expression. Soil copper anomalies up to 300 ppm are probably too small to be of interest.

Conductor 34 was located, but showed no other geophysical expression, and only low soil metal values. High soil arsenic on the west bank of the Kartuni River is not related to the conductor.

Conductor 41 showed up well in Turam, magnetic and gravity metric surveys and was also associated with a soil nickel anomaly reaching 225 ppm. on 20 ppm background increasing with depth. Specks of chalcopyrite were seen in andesite float.

Conductor 85 also showed up well in Turam and S-P surveys and carried an associated gravity high. There is no corresponding soil metal anomaly and though locally auger samples showed high nickel (up to 400 ppm. on 30 ppm background) the conductor probably reflects carbonaceous material.

Conductor 89 was confirmed on the ground but showed no magnetic or scintillometric expression. Soil copper and nickel did not reach interesting values.

Conductor 90 was confirmed on the ground, and was associated with a gravity high. Magnetic and S-P anomalies were confined to the eastern end and soil copper and nickel were low.

Conductor 94 did not show up on an E-M gun and magnetometer reconnaissance, and soil copper and nickel values were not significantly high.

Conductors 155 and 164 were traversed with the scintillometer, but no anomalous readings were found.

Of the conductors examined during this expedition, only Conductor 41 is recommended for drilling.

2. Omai and adjacent areas: geophysical and geochemical follow-up of A.E.M. anomalies by S.N. Saha, U.N. Geophysicist, April - May, 1969.

Four airborne ("Input") E.M. anomalies in Area E15 were examined using ground geophysics and soil geochemistry. They were chosen partly on the basis of Guardia and Collins' geological reports on the area and partly on the new criteria for the evaluation of AEM "Input" anomalies suggested by Mr. Schuur, until recently senior geophysicist of Canadian Aero Mineral Survey Ltd.

The central part of 6 channel Conductor 13 covers the Guardia/Collings' Anomaly A on the south flank of Quartz Hill, believed by them to be a slightly mineralised shear zone. The present surveys delineated an EM magnetic anomaly in the southeast corner, closely followed by a large Turam anomaly and a small broad gravity high. No S-P observations were made, but "the conductor can safely be interpreted as a relatively narrow metallic body of good electrical conductivity and continuity and is magnetic in nature" (S.N. Saha).

Conductor 12 lies immediately south of Guardia's stream Anomaly B and is in an area of intermediate volcanics. Two ESE conductors were recognised on the ground together with a distinct magnetic high to the north. Soil copper values of 150 ppm on a background of 40 ppm are associated with the northern conductor, and increase to 250 ppm at 12' depth.

Conductor 18 lies 2½ miles south of the Essequibo River near Omai, and was chosen on Schuur's criteria. The area is covered by the White Sand Formation and shows no outcrops or float. Ground survey indicated two or possibly three conductor striking E-W. One of these is 2000 feet long and coincident with magnetic anomalies of 200-300 gammas. There is also a small gravity high parallel to an anomaly immediately north of the conductor. Geochemical samples were taken from clays found by augering through the sand, and are being analysed. Preliminary results show a background of 10 ppm copper and 10-20 ppm nickel.

3. Tamour and Barabara Aero-Magnetic Anomalies: ground follow-up by A.K. Gibbs, Second Season 1969.

U.N. aeromagnetic surveys showed two anomalies east of the Bartica-Potaro Road around Mile 59. One of these lies north of central Tamour River; the other, near Barabara River Head lies north of the compiled aeromagnetic survey but was nevertheless detected by the aero magnetometers.

The whole region is blanketed by at least 150 feet of loose sands, and underlying clay. Tholeiitic dolerite dikes striking 060° project above the sand in several areas, and form weak anomalous patterns of the aeromagnetic map.

The only other rocks seen in the vicinity of the Tamour anomaly, and consist of amphibolitic gneisses and schists to the south of the anomaly, hornblende-biotite granodiorite to the south and west, and scattered outcrops of massive hornblendite in the vicinity of the anomaly itself. Foliation attitude is variable, but strikes are predominantly 060-080 degrees. A lineation and second foliation are present and there is evidence of at least two sets of folds. Minor very fine grained pyrite is very often present in the gneiss and schists, both in small veins and disseminations. Several of the amphibolite exposures carried enough magnetite to create a strong magnetic anomaly immediately over them and similar material may be responsible for the four small magnetic anomalies of up to 2000 gammas found by the ground geophysics. Stream sediments showed no significant base metal content.

No rocks were found in the vicinity of the Barabara Anomaly which is in the form of a magnetic ridge striking east with values up to 2500 gammas above background. It closes abruptly to the west, where the causative body may be displaced by a right lateral fault: to the west further high values form another anomaly whose extent will be determined by the new aeromagnetic survey planned for 1970. No sediment sampling was carried out here, owing to the thick sand cover, but geochemical sampling of Baramalli trees for base metals was undertaken, and the results are now being assessed.

4. Kaburi Anorthosite and Kaburi Mouth aeromagnetic anomaly, Mazaruni River. Geological, geophysical and heavy mineral survey by J.D.N. Punwasee, Second Season 1969.

An aeromagnetic anomaly of 4500 gammas some 7½ miles southeast of Kaburi Mouth was recommended for investigation by the contractors. Ground magnetics showed a northeast belt of high values in the east of the area. These reached 10,000 gammas on a background of 4000 gammas, and seem to correspond to a belt of amphibolite. To the east, white sand probably overlies granitic rocks.

A 15 mile traverse up the Kaburi from its mouth intersected acid intrusives, gneiss, and intermediate to basic volcanics before reaching the anorthosite. The latter carries subhedral crystals of labradorite up to more than an inch across with interstitial green hornblende which occasionally forms monomineralic clots. Reports of molybdenite have not been confirmed, but numerous mineral concentrates from the Kaburi and its tributaries are being examined.

No geochemistry has been carried out in the area, but a pit was dug on one of the magnetic highs, and the clays scanned on the spectrograph. None of the metals looked for were present in significant amounts.

C. DIAMOND DRILLING OPERATIONS

1. Groete Creek Gold-Copper mineralisation: completion of drilling at southwestern end of prospect by M.C. Hamilton, First Season, 1969.

During the first field season 1969, operations in the Groete Creek Area were continued to include drilling of the 2000 ft. section southwest of the major soil copper-anomaly in Block "A". Geochemical soil and stream sediment sampling of the adjacent area was continued.

At the end of the season a total footage of 2,976 ft. of rock was drilled in three inclined holes aimed at intersecting the assumed lateral extension of the mineralised body. Only one hole, viz. diamond drill hole 50, succeeded in intersecting what could be described as a mineralised zone. Assays on the drill cores recorded the occurrence of a 25 ft. section between 1019 and 1044 ft. showing 0.2% copper; a somewhat richer 10 ft. section within this zone (1029-1039 ft.) recorded 0.45% copper. The two drill holes (DDHs 49 & 51) west of this locality failed to intersect any significant concentrations of copper sulphides.

From the 2000 ft. of strike drilled, only the 600 ft. immediately west of Block "A" have revealed continuity of the zone. Although this increase brought the strike length of inferred copper mineralisation up to 5600 ft., a marked downward displacement of the horizon of ca. 600 ft. over the 5600 ft.strike was indicated with no marked improvement in grade or tenor. These factors clearly set a limit to the endeavour to extend the lateral component of the orebody along strike and drilling was stopped.

A geochemical grid measuring 6000 x 8000' west along the strike was sampled at 100 x 500' intervals. The highest soil copper (colorimetric) value was 200 ppm. on a background of 30-40 ppm. On previous experience in the area this cannot be regarded as anomalous and in fact DDH 51 drilled to intersect the horizon corresponding to the best soil values showed no significant mineralisation. Stream sediments were examined as far west as Pullantedam, preparatory to a soil survey during the second field season (q.v.).

2. Nickel-bearing laterite in the Kauramembu Mtns. Barama River; Drilling programme supervised by G. Vallance, First Season 1969.

A considerable part of the world's supply of nickel is mined from laterites associated with ultrabasic rocks, and geochemical surveys during 1968 showed this favourable geological environment to exist in the Kauramembu mountains, together with high nickel and chromium in the associated lateritic soils.

During 1969, the area was examined in more detail, and 28 vertical holes, totalling 1057 feet, were drilled to investigate nickel values in the overburden.

The country rocks are sediments (including graphitic pelites) metamorphosed basic intrusives and amphibolites. The ultrabasics are nearly vertical dykes up to 700 feet wide and trend to the southeast where they end less than 1000 feet from the Wanamu granite. The ultrabasics are partly serpentinised, and their lack of alteration close to the granite suggests that they were intruded later than the granite. Unweathered samples usually contain olivine and clinopyroxene. Magnetite, chromite and magnesite also occur.

Most of the area is undergoing rapid erosion. In these nickel values in soils overlying ultrabasics are about .4% and may increase slightly with depth; the depth being generally from 0 to 20 feet. In some parts of the area, however, lateritic duricrust has developed at altitudes of 800 to 1100 feet above sea level. Nickel values are low in the duricrust itself, but in the residual clays below the duricrust nickel values rise to about .8% at about 20 feet depth and then gradually decrease to about .3% at the ultra basic bedrock which lies at 50 to 70 feet depth. There does not appear to be any concentration of garnierite at the depth of the bedrock. Highest nickel values are about 1% and there do not appear to be any significant reserves of workable ore.

3. Upper Demerara copper prospect, six miles southwest of Great Falls. Drilling program supervised by A.K. Banerjee, U.N. Economic Geologist, First Season 1969.

Ground Investigation of airborne E-M ("Input") anomaly 175 during 1968 had delineated 2 conductors, associated with magnetic and gravity highs, and 500 ppm soil copper in trenches. Geologically this appeared to reflect mineralisation along shears in amphibolite running sub-parallel to the contact of the granite. During the present season 5 holes were drilled in both directions beneath. Depths between 600 and 804 feet were measured along the holes.

These holes showed best values of only .08% Cu over 100 feet and .2% over 5 feet, i.e. little better than the values in the trenched weathered material.

The country rock types were mainly amphibolite and hornblende schist with minor meta-andesite and metasediments. The latter include tuffaceous quartzite, breccia, welded tuff, greywackes and grey phyllites. The amphibolite carries 2-10 foot wide magnetite-rich bands which may be responsible for the magnetic and E-M response. The granite, which passes into granodiorite by increase of plagioclase, carries hornblende and minor biotite as mafics, but the former is largely replaced by chlorite. Sphene is a common accessory.

The principal foliation and the bedding are sub-vertical and strike between east and east-southeast. Locally there is a northwesterly trending later foliation and small folds are sometimes visible.

Mineralisation consists of thin stringers and dissemination of pyrrhotite, pyrite and chalcopyrite. The drill, equipment and fuel were carried by helicopter from the foot of Great Falls.

Soil surveys over 4 square miles to the northwest of AEM anomaly 175 showed two E-W copper anomalies bounded by the 300 ppm contour. The easternmost of these, over amphibolite, measured 4000 x 200-600 feet, while the western one over tuffaceous metasediment, was the same width, but only 1500 feet long. The highest value was 1120 ppm copper, on a background of 80 ppm. Sampling intervals were 100 x 500 - 1000 feet.

It is suggested that the low ratio (1:1) of soil copper to rock copper in the drilled area may reflect the pH and hence the rock-type. For this reason, pH and related factors should be given greater weight, in similar operations in future.

4. Jubilee Creek Goldfield, Puruni River. Drilling programme supervised by G. Vallance, Second Season 1969.

This prospect lies some 4 miles south-southeast of Peters' Mine, and a shaft sunk on it in 1907 by the same company who were operating at Peters' gave very encouraging results. The country rock is a diorite, intruded by a very leucocratic granite. A 15' wide shear zone in the diorite dips about 52° to the south-southeast, and carries the principal auriferous quartz veins. The largest of these encountered so far is 2 feet wide and carries .2 oz per ton in the drill intersection. A dump nearby carried between .1 and .9 oz. per ton.

1,717 feet was drilled in five vertical holes. Overburden was sampled in all except hole number four. Each hole intersected the shear zone, which was shown to be striking about 75° magnetic, and dipping at about 53° to the south. East of the eastern end of the open cut the shear zone is displaced about 100 feet to the south by a fault, and further to the east the width of the shear zone decreases markedly. Structural control of the shear zone is not understood at present but may be related to the granite encountered below the shear zone in holes 3 to 5.

DDH 1 (30 ft. southeast of the old shaft) intersected the shear zone in overburden between 50 to 75 feet, and showed about 0.03 oz per ton gold over this 25 feet. Quartz at 52 feet showed visible gold. Bedrock was diorite. DDH 2 (50 ft. south of DDH 1) intersected the shear zone from 125 to 150 feet. Assays (incomplete) indicate about 0.03 oz per ton over 25 feet, with values of about 0.2 oz per ton in the top 5 feet of the shear zone. Quartz at 129 feet showed visible gold. DDH 3 (300 ft. east and 100 ft. south

of DDH 1) intersected the shear zone from 274 to 335 feet. The rock below the shear zone was a granite. DDH 4 (600 ft. east of DDH 1) intersected the shear zone from 125 to 166 feet. The granite contact was at 344 ft. DDH 5 (800 ft. east and 50 ft. south of DDH 1) intersected the shear zone from 260 to 260 to 265 feet, and the granite was encountered at 429 feet.

Abundant pyrite was encountered in holes 4 and 5 just above the granite contact. Assays are not yet available for holes 3 to 5, but present evidence suggests that there may be an additional factor responsible for the high values in DDH 1, and further drilling is planned to investigate this as well as to follow the shear zone to the west.

5. Ianna Gold/Molybdenum Prospect, Barama River. Drilling programme supervised by A.R. Westerman, Second Season 1969.

Intensive geochemical and geological work over the Ianna stock during 1968 showed high soil molybdenum values associated with the roof of a leuco-tonalite stock. Both the molybdenum and worked gold deposits appear to be related to shear zones and roof joints associated with emplacement of the tonalite and mainly in a thick carbonated greenschist and greywacke unit.

Two holes totalling 1553 feet were drilled and were numbered 3 and 4 to follow the numeration of the two drilled north of Ianna in 1966. DDH 3 was intended for structural information and intersected 500' of mineralised shear zone dipping in the direction of a soil molybdenum anomaly in the vicinity of the old Paymaster gold workings. The hole oriented 55° to the north, intersected some 113' overburden followed by greywacke interbedded with feldspar porphyry. After 188' of overburden No. 4 was completely in an oligo-

clase diorite, which started in a xenolitic marginal facies. It intersected the northern edge of the lower intensity soil malybdenum anomaly at Paymaster and carries minor amounts of molybdenite both in a shear zone and in the margins of a roof joint quartz vein, also some chalcopyrite. Continuous assay for gold, silver, copper and molybdenum are completed for DDH 4: one 200' section averages 0.01 oz/ton gold, but the other elements are not present in significant amounts.

Drilling will continue in 1970, when it is hoped that many of the transportation problems encountered in 1969 will have been overcome.

The Barama River section around Kokerite was visited with C.N. Barron for several days, and the local Stratigraphy and Structures of the Kokerite Formation were worked out. However, problems were still posed by the inverted bedding just south of Maikuru Rock, where two anticlines of parallel plunge face one another, one being inverted and the other right-way-up.

Wanamaishuru Wupwu, near Towakaima, was revisited. It was shown to be a differentiated basic/ultrabasic body with extensive hornblendite. Specimens are being assayed for Cr, Ni, V. Probably 1/2 square mile of laterite duricrust cap obtains.

D. REGIONAL GEOLOGICAL MAPPING

1. Photogeological Surveys of Southern Guyana.

Dr. J.P. Berrange of the Institute of Geological Science in London, continued his third year of photogeolgical interpretation and field checking in the southern portion of the country. With the assistance of Dr. Richard Johnson, also of the Institute of

Geological Sciences, Dr. Berrange successfully covered the south-western quadrangle of his Project area in some of the most difficult Amazonian forest terrain of the country. By year end Dr. Berrange had produced a geological compilation of 3 quadrangles of the portion of Guyana shouth of the 4^{o} parallel.

E. MINERAL RESOURCES APPRAISAL

Matthews' Ridge Managanese Mine: Appraisal of Geology and Mining Operations by A.R. Westerman, Feb.-July, 1969.

The Matthews' Ridge Manganese Mine, N.W. District, closed down at the end of 1968. During the first half of 1969, A.R. Westerman of this Department undertook the following investigations.

1) Categorisation and compilation of the outgoing Company's chaotic Geological and Survey Records. These are being used together with other material to compile a number of new Quarter Degree Geological Maps of the north of Guyana.

2) The Structural Geology of the Mine. This is complex, but is necessary for an effective calculation of reserves and for guiding further exploration. A photographic record of the structures was also made.

3) Examination of South Horizon, North Prospect, and appraisal of the Company's estimate of reserves of

60,600 recoverable tons at 39% Mn (after washing)

40,830 " " " 36% " " "

4) The Assay Laboratory records were processed to show the variation of Mn, SiO_2 and R/v throughout the mine, and the behavious of the ore in the Mill.

5) Samples were taken throughout the mine, so that Al_2O_3, Fe_2O_3, P and density variations could be added to the mine assay data. It is hoped that eventually these samples can also be examined mineralogically.

6) The Washing Plant was run in the presence of Mr. L.F. Heising, of the U.S. Bureau of Mines, and samples were taken. These suggested that Heavy Media might improve the grade by 2% Mn over the present 36% Mn material recovered from the Wemco-Remer Jig and hand picking methods.

7) Reserves based on checking of company records are at Matthews' Ridge, 318,059 recoverable tons at 37% Mn; at Pipiani, 36 miles to the east-southeast reserves are:

Minimum 534,155 recoverable tons at 42% Mn.

Maximum 825,852 " " " 42½% Mn.

This would indicate total reserves of 1,000,000 recoverable tons averaging 40% Mn. Heising's financial analysis indicates that the road to Pipiani would have to be built on separate capital, and the necessary mining equipment would require another means of completing its amortisation and working lifespan.

8) Discovery of sizeable Molybdenum and nickel deposits in addition to manganese would provide the basis for an economic ferro-alloy industry, based on the Matthews' Ridge transport system. To this end, expeditions were made to the Whanna River, the best local airborne E-M anomaly, Kopinamai, Port Kaituma and Arakaka. The first three of these merit further work.

Progress at the nearby Ianna molybdenum prospect is described separately.

F. ENGINEERING GEOLOGY PROJECTS

1. The availability of stone for engineering construction.

The Director continued to give advice to the Ministry of Works and Hydraulics on the availability of stone for projected constructional works by Government. Clearing of a new quarry site proposed by the Geological Survey had commenced by year end.

2. Hydro-power development at Tiboku.

The Director continued to serve as a member of the Technical Co-ordinating Committee on the Tiboku Hydro-Power Project.

3. Higher Diploma Course in Civil Engineering at the University of Guyana.

The Department undertook, at the request of the University of Guyana, the running of a course in Geology for students taking the Higher Diploma in Civil Engineering. Dr. M.A. Lee,

Mr. C. N. Barron, Dr. A. Choudhuri and Dr. S. Singh provided the lectures, practicals and tutorials for both day and evening classes.

IV. UNITED NATIONS-GUYANA MINERAL SURVEY PHASE II

This Project came to a conclusion in November and by early December all U.N. personnel except Dr. A.Z. Gedeon left. Equipment supplied by United Nations were handed over to the Department. Field work carried out under the Project for the year is described in the Summary of Field Work. The final report for this Project is expected to be completed during the first half of 1970.

Following discussions in New York with United Nations Development Programme and its Executing Agency, there was an indication that U.N. may continue the services of its specialist personnel who were engaged in Guyana for a further period of one year as Technical Assistance.

V. TECHNICAL ASSISTANCE TO WEST INDIAN ISLANDS

The Director visited Dominica from January 19th-23rd to assist that Government in planning its geological programme for the year.

The two Dominican geological assistants who received training in Guyana in 1967 returned during the year for further courses. Mr. Walter Williams, who spent 3 months in Guyana from August to October, was given training in photo-geological interpretation; elementary petrography; heavy minerals studies and

and field geological and geochemical techniques. Mr. Alwyn Shillingford who spent 2 months in Guyana during September and October undertook an expanded course in colorimetric analysis and heavy mineral separation and identification.

Mr. W. Williams was accorded the opportunity of participation in the Technical Sessions and Field Excursions arranged for the Eighth Guiana Geological Conference which was held in Guyana during August.

VII. MINERAL DEVELOPMENT

Bauxite: Bauxite production for the last five years is shown below. Total bauxite production for 1969 amounted to 4,238,346 long tons as compared with 3,664,541 long tons tons for 1968. An increase of 573,805 long tons. Alumina production for the year was 293,370 tons. An increase of 28,088 tons over the 1968 production of 265,282 tons. The increased production is due to the operating efficiency of both companies and also to the fact that in terms of the 1965 Agreement between the companies and Government, which came into effect during 1968 the companies stand to benefit by way of reduced rentals on their Exclusive Permissions if production is progressively increased.

Demerara Bauxite Company Limited: At the time of writing this Company's report on exploration for the year 1969 had not reached this office.

Reynolds Guyana Mines: New equipment at Kwakwani - Cat trucks and self loading scrapers - are working well and have contributed to the increased production. The calciner at Everton is increasing its production, and with new refractories and feed preparation a 30% increase is expected for 1970 over the 1969 figures.

Five four-wheel drive truck mounted Mayhew rotary drills and one crawler mounted Mayhew rotary rig were in use during 1969.

Bauxite Production (Long Tons)
1965 - 1969

Production Company	1965	1966	1967	1968	1969
Demerara Bauxite Co. Ltd.	2,437.444	2,712,527	2,507,758	2,759,524	3,116,413
Reynolds Guyana Mines Ltd.	435,044	592,174	897,724	905,017	1,121,933
Total	2,872,488	3,304,701	3,405,482	3,664,541	4,238,346

GOLD AND DIAMONDS

The production of gold and diamonds is given in the tables below:

Gold Production (Troy ounces)
1965 - 1969

Districts	1965	1966	1967	1968	1969
Berbice	-	1	-	-	-
Potaro	335	459	224	163	86
Mazaruni	470	679	350	3,199	1,258
Cuyuni	338	603	472	297	317
North-West	776	1,285	1,330	394	399
Rupununi	158	18	3	35	42
Total	2,067	3,045	2,379	4,088	2,102

Diamond Production (Metric Carats)
1965 - 1969

Districts	1965	1966	1967	1968	1969+
Berbice	391.19	1,446.63	445.37	-	.19
Potaro	16,571.57	10,387.34	11,161.72	11,648.51	9,923.51
Mazaruni	80,429.91	71,817.63	74,020.28	43,602.74	31,026.86
Cuyuni	10,806.92	8,887.98	5,897.95	4,864.76	3,504.52
North-West	-	-	-	-	-
Rupununi	4,674.02	6,347.31	5,826.36	6,195.57	4,811.20
Total	112,873.61	98,886.89	97,351.68	66,311.58	49,266.38

The decline in gold and diamond production may be more apparent than real. In the case of diamond production, the number of people engaged in this pursuit has certainly not decreased. It is known that a great deal of smuggling of both these minerals is prevalent and therefore the official figures are considered to be highly unreliable.

OIL

Continental Oil Co. & Tenneco (Guyana) Inc. Data collected during the company's seismic programme to help define an apparent structural anomaly located in the eastern most portion of O.P.L. #209 indicated a significant tertiary structure, trending N.W. - S.E. near the shelf edge and located on the border of Continental-Tenneco, and the Shell concessions. Technical meetings were held between the two companies, to determine if the anomaly justified drilling, and

+ The 1969 figures do not include 2,282.64 metric carats seized by Customs Officers at Timehri Airport.

if so, to select a mutually agreeable well site. Special attention was given to the horizons operating conditions due to extreme water depths, as well as the geological questions pertaining to the merits of the anomaly.

Guyana Shell Ltd: Oil prospecting Licences #212-220 were surrendered by this company during the year. Data collected during seismic surveys over the area held under O.P.L. #211 is still being evaluated and processed.

RADIOACTIVE MINERALS

Both Dennison Mines Ltd. and Cominco continued their prospection for radioactive minerals with encouraging results so far. Dennison have relinquished most of the ground they held under Exclusive Permission Licence #1, but the company was preparing to intensify ground work on selected portions of the area and drilling was to be started early in 1970.

General Comments and Conclusion:

Information has reached this Division that there are a number of persons in the interior who are prospecting and mining for gold and diamonds without being the holders of prospecting licences and mining privileges. The fact that this goes on with impunity reveals the weakness in the mining administration and supports the view that the Assistant District Commissioners who have taken over the duties of Mines Officers are not performing those duties efficiently or effectively.

For quite some time this Division has suspected that diamonds were being smuggled out of the country, but to what extent was not known until Mr. Aron Reh was caught red-handed with a parcel

weighing 2,282.64 metric carats valued at over $80,000.00. If illegal mining is allowed to go on it should not be surprising that diamonds so easily get into the hands of smugllers. And we will continue to lose revenue annually on an increasing scale until the Mines Division is strengehened by the provision of a sufficient number of field and office personnel.

VII. HEADQUARTERS WORK

Analytical Laboratory.

The Sample Preparation Section received a jaw-crusher, a pulveriser and a mechanised agate mortar. The use of plastic bags was reintroduced for wet samples, the use of craft paper bags will be continued for dry samples. Aluminium tags are used to label samples in plastic bags.

Construction of the new Fire Assay Section was completed and it showed considerable increase of output.

The Atomic Absorption Spectrophotometer suffered a breakdown of two tubes, which were replaced.

Some modifications of the techniques of Spectrographic analysis were made in order to increase reproducability.

In the Balance Room a concrete slab was cast for the analytical balance to eliminate vibration.

Laboratory work was geared principally to supplement geochemical-geological field prospecting.

Mr. M.D. Hope attended a short refresher course in fire assaying in the U.S.A. and returned to Guyana in February.

The summary of work done in the Analytical Laboratory during the year is as follows:

Sample Preparation

Geochemical (soil and stream sediment)	11,831
Core	807
Rock	217
Spectrographic (reground in agate)	2,368

Colorimetric

Georgetown	12,014	samples,	22,436	determinations
Field laboratories	5,058	"	12,297	"
Atomic Absorption Spectrometer	807	"	1,105	"
Fire Assay	768	"	1,589	"
Wet Assay	63	"	233	"
Spectrographic	7,594	"	37,609	"

Petrological Laboratory.

During the year the Petrological Laboratory assisted in identification of rocks and mineral samples collected by geologists from various project areas in Guyana. The methods included routine petrographic examination, refractive index determination and X-ray diffraction.

A total of 975 sections were made and 31 polished sections for examination of ore minerals. A new polishing machine, press, pre-heater and accessory materials were acquired from Buehler for bakelite premoulds and a start was made in mounting of polished sections in bakelite.

Microscope accessories acquired includes stage micrometers and reticule eyepieces for the two Leitz Laborlux microscopes and refracting prisms for the Leitz-Jelly refractometer.

A new ammeter and slope-feed socket were fixed to the Frantz Isodynamic Separator as the old components were beyond repair. Heavy mineral separation with bromoform and the Frantz Isodynamic Separator were carried out by Mr. Sat Narain. Similar separation is now being done on stream concentrates by Mr. A. Gibbs and Mr. J. Inasi. For the purpose of correlation a study of zircons from the granitic rocks of the Ianna stock, N.W.D., collected by Mr. A.R. Westerman was initiated. This is now being completed with the help of Mr. Sat Narain; it is hoped that the study will be extended to neighbouring rocks in the area after Mr. Narain completes his study abroad.

Rocks examined and identified in the laboratory include acid and intermediate volcanics, sedimentary and metamorphic rocks from the North West District, Central Cuyuni, Ichaura and Tamour regions. For the identification of clay minerals X-ray photographs were taken with a Debye-Scherer powder camera at the Government Analyst Department. A brief refresher course in mineralogy was held for Messrs. Williams and Shillingford from Dominica. Samples of typical ores and ore minerals of Guyana, such as bauxite, gold in quartz, magnetite, hematite, molybdenite, chalcopyrite and white sand have been loaned to the Guyana Development Corporation for display at the Guyana pavilion at Expo'70.

Drawing Office

Staff:

Mr. R. Narain was promoted retroactively to the post of Senior Assistant Draughtsman. Mr. A. Brathwaite, was appointed retroactively to the post of Apprentice Draughtsman, and was promoted to the post of Assistant Draughtsman with effect from 1st September. Mr. Brathwaite has been participating in a Course at the Technical Institute from October 28th. This day-course in Cartographic Draughting offers two classes per week (Tuesday and Wednesday) and runs for one year in the first instance. Mr. M.D. Hope assumed duty as Apprentice Draughtsman with effect from May 12th. Mr. J. Rambali, Assistant Draughtsman resumed from Vacation Leave on January 5th. Mr. M. Persaud, Assistant Draughtsman was on 90 days' Vacation Leave from August 4th to October 31st. Mr. T. Singh, Apprentice Draughtsman and Miss G. Joseph, Apprentice Draughtsman resigned with effect from 1st August and 1st September respectively.

Training

The Drawing Office offered training during the year to Mrs. S. Tappin and Mr. W. Williams who were here for a short period. Mrs. Tappin, a trainee draughtsman at the Cartographic Section of the Demerara Bauxite Company was given 8 weeks' training in Cartographic Techniques (March 16th to May 10th). Mr. W. Williams, a Field Officer at the Crown Lands Office in Dominica, received training in photogrammetric techniques from August 18th to September 5th.

Illustrations, Compilation and Mining Records

Two hundred and thirty four (234) illustrations were traced including 64 for the U.N. Mineral Investigations Project. Forty(40) maps from the record of Manganese Mines Management Co. were transferred from Matthews Ridge for compilation of Manganese Horizons Map, and of a geological map (Scale 1:50,000). The latter was a large scale operation and by year-end, three of the four large sheets covering the Barima-Barama-lower Cuyuni area were completed. Other compilations included a map of Northern Guyana showing coverage of Soil and Stream Sediments Sampling, two preliminary Quarter Degree Sheets (Omai S.W. Kurupukari N.W.) and a photo-mosaic of the Northern half of Guyana (1:500,000).

Fifty (50) maps or sketches were traced for mining applications and records.

Supplement to Bulletin 38.

This report, produced in September in cyclostyled form, included 19 Dyeline illustrations. The cover, designed in the Drawing Office, was processed to the lithographic plate stage in the Photolaboratory to be reproduced on the presses at the Government Printery. Two hundred of each illustration were copied (3800 dyeline prints in all), and this necessitated 40 hours overtime by Drawing Office Staff to meet the deadline.

Photo-laboratory.

This Section of the Drawing Office was fully occupied during the year, producing for internal and external needs. There was need at peak periods to assign an assistant to the regular technician.

Organizations requesting services of this section during the year included:- the Police Security and Traffic Branches, Roads, Sea Defence and Hydrometerological Branches of the Ministry of Works and Hydraulics, Soil Survey, Cartographic, Land Development and Livestock Section of this Ministry, the Guyana School of Agriculture, U.N. Forest Project and U.N. Forest Industries Survey, Bishops' High School, Denison Mines and the Guyana Development Corporation.

Colour-Separation Overlays were prepared at the request of the Cartographic Section for the publication of a three-colour Tourist map of Georgetown. Lithographic plates were prepared for some of the illustrations (including 4 photographic plates) for the proceedings of the Seventh Guiana Geological Conference published in August.

Filing and Indexing, Dyeline prints

Maps files and indexed included one hundred and thirty-eight (138) illustrations for geologists' Expedition Reports and 110 field maps.

A record number of dyeline prints (1422) were made for other Departments including 690 prints of Organization Charts for the Public Service Ministry.

Summary of Production

Tracings Prepared:	Illustration's for Report	- 234
	Mining Maps	50
	Miscellaneous maps	36
	TOTAL	320
Maps Filed and Indexed:	Illustration's for Reports	- 138
	Foreign maps	15
	Field maps	110
	Field Note Books	15
Dyeline Prints Made:	Illustration's for Reports	- 6,900
	Miscellaneous Internal Requests	2,178
	Other Departments' Requests	1,422
	TOTAL	10,500
Photographic Prints Made:	Transparencies	276
	Negatives	530
	Paper Prints	610
	Lithographic Plates	20
Revenue from Services Supplied to External Agencies:		$508.15

Library and Publications

At year end the stock of books in the Library was 13,771. 62 new books which have been recommended by the geologists for inclusion in our Library stock were ordered during the year. 445 books and periodicals were also received as gifts through our international free distribution arrangements. Geological periodicals and magazines from 61 international institutions were subscribed to during the year.

The number of books handled during the year was as follows:

Classified	..	..	215
Accessioned	..	..	447
Borrowed	..	..	853
Returned	..	449	
Still on loan		404	
Total		853	

The following new publications were printed for sale and free distribution during the year:

Records No. VI	634
Annual Report 1968	300

Table II hereunder lists the distribution and disposal of printed and cyclostyled publications.

Table II

	Sold	Free	Total
Bulletins	250	214	464
Annual Reports	75	268	343
Records Vol., 1-6	150	300	450
Mineral Resources Pamphlets	68	208	276
Publications for free distribution.		452	452
Miscellaneous Reports	9	10	19
Maps	532	1,157	1,689
	1,084	2,609	3,693

Radio and Geophysical Workshop

Mr. R. Belletty, Technical Assistant Grade I continued in charge of the repairs and maintenance of Radios and Geophysical equipment in the Geological Survey Department.

In January the crystals arrived for the Department's new frequency of 5250K/HZ. These were installed, and the new network went into operation during the first field season. The installation

of this new frequency has enabled the Department to become independent of the Government interior Radio Service (8RA) and has resulted in much greater efficiency and expediency for geological field parties. The field network now operates with 11 RCA's used as mobiles in various parts of the interior. An RCA and a Collins coupled and fitted with Voice Operated Relays (VOR) and Electronic Telephone Couplers (ETC) are operated as base units at Headquarters in Georgetown. This new principle of operation now contributes an eight hour a day radio link between field parties and headquarters with the exception of Sundays and public holdiays.

The Department's Radio Technician assisted the Forestry and the Soil Survey Departments in maintaining their radiophones through the year. Regular service checks were carried out on other electronic and electrical equipment in the Department, mainly the chemical laboratory and the new fire assay laboratory.

The serviceable Geophysical instruments at year end were:-

2 Turam Electromagnetic Units
1 Abem EM Gun
1 Pye S-P Potentiometer
1 Sharpe combined SP-resistivity set
4 Sharpe Schmidt type Magnetometers (2 vertical, 2 horizontal).
3 Askania Torsion Magnetometer (2 vertical, 1 horizontal).
1 Elsec Proton Magnetometer.
1 Sharpe S-P Potentiometer

Mechanical Workshop

The mechanical workshop is responsible for repairs and maintenance of all mechanical equipment in the department and for transportation services as required. A staff of three permanent Driver/Mechanics fell under the supervision of

Mr. Albert Edwards, Foreman/Mechanic.

During the year the Driver/Mechanics were responsible for the upkeep and maintenance of the diamond drills while in the field.

Mr. B. Singh, Driver/Mechanic resigned with effect from 31st December, 1969.

The active equipment held at year end were:

4	Land Rovers
1	Morris J2 Van
1	Land Rover Truck
2	Tractor - Dexter and Fordson Major with trailers
2	Bombardier Muskeg tractors with trailers
12	Small outboard engines (Seagull)
33	Medium " " (Archimedes)
4	40 h.p. " " (Johnson)
1	33 h.p. " " (Johnson)
3	40 h.p. " " (Evinrude)
1	33 h.p. " " (Evinrude)
4	12 Volt J.A.P. Charging Plants
6	Honda Generating Plants
2	Petter Engines
4	Chain Saws
1	Fairbanks Morse Generator
1	Good Enough Pump
1	Warsap Rock Drill
6	2500 Watt Winpower Gasolene Electric Generators
1	Boyles BBS 17A Diesel Drill
4	Boyles BBS 1 Gasolene Drills, two with Hydraulic feeds.
1	Acker Hillibilly Gasolene Drill
8	Boyles Bros. pumps

VIII. CONFERENCES AND VISITS

The Eighth Guiana Geological Conference was held in Georgetown in August 1969. There was a pre-Conference excursion to Kaieteur on 8-10 August which was followed by the Technical Sessions from 11-15 August with a break on 13th August to visit the bauxite mines at McKenzie. A final excursion to the Rupununi

on 16-18 August brought the proceedings to a fitting closure.

The Conference was attended by some 70 delegates representing 12 countries. This conference saw a shift towards an economic bias, many papers dealing with problems encountered in mineral exploration in a tropical environment, particularly with regard to Guyana. There was lively and sometimes prolonged discussion following some of the papers but from available data no clear answers emerged. What appears to be certain is that much more basic research needs to be carried out in the tropics before geophysical and geochemical results can be interpreted in terms of possible mineralisation. The proceedings of the Conference will be published shortly.

Other Conferences:

The Director, Dr. Sobharam Singh attended a meetiing of the Committee for Tectonic and Metallogenic Maps of South America - Lima, Peru from 5th to 16th May. The Director accompanied the Minister of Agriculture and Natural Resources, the Hon. R.J. Jordan and his Permanent Secretary, Mr. F.A. Noel on a mission designed to promote and stimulate overseas interest in mining, mineral and agricultural development in Guyana. They visited New York, Washington, Montreal, Ottawa, Toronto, Stockholm and Bonn.

Dr. M.A. Lee, Deputy Director and Mr. M.C. Hamilton, acting Senior Geologist, represented Guyana at the Fourth Venezuelan Geological Congress from 16th to 22nd November, 1969.

APPENDIX I

Staff Availability
Senior Professional

Establishment	Name	Availability
1 Director	S. Singh, B.Sc., Ph.D., F.G.S., F.R.G.S., C.Eng., A.M.I.M.M.	1st January-31st December.
1 Deputy Director	M.A. Lee, B.Sc., Ph.D., A.R.S.M., D.I.C., A.M.I.M.M.	1st January-31st December.
1 Geochemist	Vacant	
1 Geophysicist	Vacant	
1 Petrologist/ Mineralogist	A. Choudhuri, M.Sc., Ph.D.	1st January-31st December.
4 Snr. Geologists	C.N. Barron, B.A., F.G.S.	1st January-31st December.
	G.A. Sampson, B.Sc., F.G.S.	Proceeded on Commonwealth Fellowship Training from 10th Sept., 1968.
	2 Vacancies	
11 Geologists	J.D.N. Punwasee, B.Sc., F.G.S.	1st January-31st December. Acting Snr. Geologist w.e.f. 1.1.68.
	M.C. Hamilton, B.A., F.G.S.	1st January-31st December. Acting Snr. Geologist w.e.f.
	H. Schielly, D.Sc., Nat. Dip. Ing. Geol.	1st January-19th August. Contract expired.
	G. Vallance, B.A.	1st January-31st December.
	A.R. Westerman, B.Sc.	1st January-31st December.
	N.R. Cameron, B.A., F.G.S.	8th August-31st December. New Appointment.
	J.C. Inasi, B.Sc.	5th August-31st December. New Appointment.
	5 Vacancies at year end.	

APPENDIX II

Summary of Expenditure 1968

a) Recurrent Expenditure

Head 29 - Ministry of Agriculture & Natural Resources - Geological Survey and Mines.

Sub-Heads:		Amt. Spent 31/12/69
1	Personal Emoluments	$228,674.04
2	Transport and Travelling	27,691.47
3	Miscellaneous	2,227.08
4	Library and Publications	3,471.24
5	Sanitary and Fuel	212.69
6	Uniforms	1,253.61
7	Study Courses	
8	Rental af Quarters	166.00
9	Labour and Rations for labourers	41,774.85
10	Land and Water Transport	3,391.97
11	Drawing Instruments, Materials & Equipments	5,391.97
12	Revenue Protection	
13	Materials for Survey	2,001.09
14	Rapairs & Maintenance for Scientific Equipment	2,627.74
15	Printing Maps & Reports	18,090.24
16	Special Scientific Research	110.23
17	Geophysical Surveys	9,853.22
	Total Recurrent	$346,903.93

APPENDIX II (Contd.)

b) Development (Capital) Expenditure
Div. XIII Ministry of Agriculture & Natural Resources.

Sub-Heads

24	Imperial College Research	6,824.22
32	Geological Surveys	508,985.71
35	Photo-Geological Survey of Southern Guyana	13,752.12
	Total Development (Capital)	$529,562.05

Total Recurrent and Development (Capital) $876,465.98