THE STRATIGRAPHY, STRUCTURE, AND GOLD MINERALIZATION OF THE JAMESTOWN AND SHEBA HILLS AREAS OF THE BARBERTON MOUNTAIN LAND

by

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ABSTRACT

The following is an account of the stratigraphy, structure, metamorphism, and mineralization found in the Jamestown and Sheba Hills areas, situated on the northwest flank of the Barberton Mountain Land. The area embraces one of the most complexly deformed and highly metamorphosed regions in the early Precambrian Barberton greenstone belt.

A brief account of the history and mining associated with the early discovery of gold in the area is outlined and a fairly comprehensive account is given of previous geological work done in the Barberton region. Particular emphasis is placed on previous work applicable to the area under discussion. The general geology, including an overall structural synthesis and the recently revised stratigraphy of the Barberton Mountain Land, is also summarized.

The geology of the Jamestown Hills area is discussed in detail and the revised stratigraphy is presented. Two formations of the Onverwacht Group, viz. the Theespruit and Komati Formations, are recognized in the area. The Theespruit Formation consists of a wide variety of thermally and dynamically metamorphosed mafic and ultramafic rocks together with minor siliceous schist and chert horizons. New chemical data relating to the amphibolites and siliceous schists is presented and discussed. The Komati Formation consists essentially of metamorphosed mafic and ultramafic rocks together with associated quartz and felspar porphyries. A series of differentiated ultramafic bodies, which probably represent sills, occur mainly within the Komati Formation assemblages but some differentiated ultramafic bodies, elsewhere in the Jamestown Schist Belt, may represent sills in the Theespruit Formation.

Rocks of the Fig Tree and Moodies Groups are developed in the eastern part of the Jamestown Hills area, particularly in the neighbourhood of the New Consort Gold Mine. These predominantly sedimentary successions are complexly deformed and have been thermally metamorphosed by the Nelspruit Granite border phase and associated pegmatites.

The structure of the Jamestown Schist Belt and the Consort Mine area is explained in detail, use having been made of minor structural techniques to unravel the tectonic history of the area which displays several phases of deformation.

The mineralization of the Jamestown Schist Belt, which includes gold, asbestos, talc, magnesite, nickel, verdite, and buddstone is described and the controlling influence of structure in the formation and localization of the mineralization is emphasized.

The Handsup-Mundt's Concession differentiated ultramafic igneous bodies, at the eastern end of the Jamestown Schist Belt, are described in detail. At least four separate cycles or pulses are evident, each beginning at the base with a serpentinized olivine peridotite, and followed, in turn, by serpentinized pyroxene peridotite, pyroxenite, and meta-gabbro. The petrography of these rocks is given and new chemical data relating to the differentiated ultramafic bodies is presented and discussed. The primary magma type is considered to have been originally of ultrabasic composition. The differentiated ultramafic bodies are considered to represent the intrusive equivalents of the volcanic ultramafic and mafic successions of the Komati River Valley.

A detailed account of the geology of the Eureka Syncline, in the Sheba Hills area of the Mountain Land, embraces a description of the stratigraphy and structure of the area. Although Onverwacht and Fig Tree Group rocks occur in the Eureka Syncline, the Moodies Group assemblages are best developed and represent the most complete succession of Moodies rocks in the Barberton Mountain Land. Three main pulses of sedimentation can be recognized. The first of these began with the deposition of the basal conglomerate, followed by calcareous orthoquartzites and felspathic quartzites, and ended with shales and banded magnetic jaspilites. The next pulse began with quartzites and conglomerates and was followed by a minor period of volcanism and a second banded magnetic jasper horizon, together with shales. The third and last pulse began with minor conglomerate and quartzite development and was followed by an alternating sequence of shales, subgreywackes, grits, and, finally, a small-pebble conglomerate. Each pulse appears to have started with an influx of coarse detritus and gradually the depositional pattern trended towards an environment that allowed for the settling out of shales and chemically precipitated jaspilites and banded ironstones. The sedimentary structures displayed in the Moodies rocks of the Eureka Syncline are indicative of deposition in a shallow water environment.

Small- and large-scale structures associated with the Eureka Syncline were employed in a detailed structural synthesis of the area. The percentage flattening of pebbles of deformed conglomerates from the Eureka Syncline was calculated and compared with values obtained for isoclinal folds found in Fig Tree strata of the Lily Gold Mine, situated six miles east of the pebble occurrences. A measure of the total deformation that affected the supracrustal rocks in the area south of

the Nelspruit Granite contact was thus obtained. Pebble data from conglomerate horizons throughout the Eureka Syncline indicates conclusively that the maximum degree of deformation occurs in those areas immediately opposite and adjacent to the granite contacts. The pebble data, furthermore, suggests that the initial sedimentation in the Eureka Syncline area was mainly from the southeast or east-southeast.

The gold mineralization in the Sheba Hills area is discussed and it is demonstrated how the ore deposits are virtually confined to suitable compressional and dilatant zones of shearing, fracturing, and faulting which resulted from the arcuation of the Eureka fold structure. Primary avenues for the mineralization in the area appear to have been the Lily Fault around the outer arc, and the Sheba Fault on the inner arc, of the Eureka Structure.

The granitic rocks on the northwest flank of the Barberton Mountain Land comprise several distinctive granite-types, each characterized by differences in chemistry, style, and mode of emplacement. The Nelspruit Granite consists of a highly varied group of granitic rocks ranging from migmatites, gneisses, and nebulites to homogeneous varieties. A mobilized border phases granite, which is strongly foliated and often lineated, is associated with a prominent pegmatitic phase. The granites of the Nelspruit terrain have been classified as granodiorites or adamellites on the basis of their potash-soda ratios. Part of the migmatite terrain may represent an early basement on to which the supracrustal rocks were deposited.

The second distinctive granite-type is that typified by the diapiric Kaap Valley Granite pluton. This body, as well as several others like it around the Barberton Mountain Land, is characterized by a low potash-soda ratio and a poorly developed associated pegmatite phase. This type of granite is usually responsible for the formation of the arcuate greenstone tongues, like the Jamestown Schist Belt, which form such a striking feature of greenstone belts. The diapiric granite plutons are also characterized by foliated and lineated margins adjacent to the supracrustal rocks, the latter having a schistosity which parallels the granite contacts. The foliation of the granites, caused by the alignment of platy minerals, becomes less pronounced and may disappear away from the margins towards the centres of the bodies. The granites are responsible for relatively narrow contact aureoles, the metamorphism seldom exceeding the lower amphibolite facies. The Kaap Valley Granite, in terms of its chemistry, may be classified as a tonalite or a hornblende granodiorite.

A further granite-type developed on the northwest flank of the greenstone belt, and elsewhere, is typified by the younger M'pageni, high-level granite pluton. These granites which are potash-rich, coarse-

grained, porphyritic, homogeneous, and non-foliated were responsible for little structural disturbance and metamorphism but generally caused abrupt truncation of earlier formed structures. These rocks have been classified as true magmatic granites.

Two varieties of quartz and felspar porphyry occur in the area north of Barberton, the one associated with the Kaap Valley Granite and the other, earlier variety, associated with the lower formations of the Onverwacht Group. These rocks are characterized by high soda:potash ratios.

The granite pebbles in the Moodies basal conglomerate indicate a distinctive graphic intergrowth of quartz and felspar totally unlike any granites present in the area today. The microgranites, which yield a high potash-soda ratio, probably represent the late-phase granites of an earlier, now unrecognizable, cycle of granite development.

The Barberton Mountain Land is believed to have undergone two main episodes of deformation, the first, which was probably the result of gravity tectonics, being responsible for the northeast-southwest trending major folds and faults, and the second, brought about by the intrusion of the diapiric granite plutons, being responsible for the superimposition of folding and the creation of complex interference structures. In the area under discussion, at least four phases of deformation followed the emplacement of the diapiric Kaap Valley Granite pluton. Four periods of mineral development closely associated with the phases of structural deformation can also be recognized together with post-tectonic recrystallization and late-stage retrogression in the waning phases of metamorphism.

Gold and silver production figures for the Barberton Mountain Land, both in the Transvaal and in Swaziland, are presented. The distribution of the gold mineralization in the area is discussed and it is shown that most of the gold, thus far recovered from the region, occurs in a relatively restricted area on the northwest flank of the greenstone belt.

The localization of the gold mineralization was controlled by a number of factors. These include the availability of suitable source rocks from which the gold and sulphides were derived, the availability of high-volatile granites responsible for motivating, concentrating, and transporting the metals and, the availability of a suitable structural environment which acted as an acceptor for the mineralization.

The gold is considered to have been derived from mafic and ultramafic source rocks of the Onverwacht Group. An important primary

concentration is believed to have taken place on the northwest flank of the Barberton greenstone belt where differentiation of Onverwacht material reached a maximum with the development of the differentiated ultramafic igneous bodies.

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CONTENTS

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CHAPTER 1

INTRODUCTION

A. GENERAL STATEMENT

The following geological report on the stratigraphy, structure, metamorphism, and gold mineralization of the Jamestown and Sheba Hills areas of the Barberton Mountain Land forms part of a systematic study programme undertaken by the Economic Geology Research Unit of the University of the Witwatersrand, Johannesburg. The investigations were initiated primarily to establish the various geological controls of gold mineralization in the Barberton area and, to assist, wherever possible, the gold mining industry in it's endeavours to locate additional ore-deposits.

Since the pioneering studies of Hall (1918) and the Geological Survey (Visser, compiler, 1956), tremendous renewed interest has been focused on the Barberton "greenstone belt" by scientists from all parts of the world. The revival of interest began in 1961, when the Economic Geology Research Unit first commenced its activities in the area with E.J. Poole studying the factors controlling the mineralization of the Agnes Gold Mine. Later, in the same year, Dr. J.C. Ramsay from the Imperial College of Science and Technology, London, undertook a brief structural study of the area north of Barberton. His work laid the foundations for the examination, in greater detail, of zones regarded as critical for the interpretation of the complex geological history of the area as a whole.

Geologists from the mining companies operating in the area, as well as a number of geologists from the Economic Geology Research Unit, began a detailed and systematic programme which necessitated much re-mapping of parts of the belt in which gold mineralization is known to have occurred. During the initial phase of the geological re-examination of the Barberton belt Dr. C. Roering carried out reconnaissance structural mapping of the Saddleback Syncline in the central part of the Mountain Land, while to the southwest of Barberton, Herget (1963) examined the structure and stratigraphy of the Montrose area. At the same time R. Cooke, geologist of the Eastern Transvaal Consolidated Mines Limited, undertook remapping of the regions centred about the Agnes Gold Mine in the Moodies Hills.

The programme of remapping was extended in 1962 with the structure and stratigraphy of the Ulundi Syncline being studied by van Vuuren (1964), and a detailed structural and petrological investigation of the New Consort - Joe's Luck Siding - Louw's Creek areas, along the

northern contact of the Barberton belt, being undertaken by Viljoen (1964) and Anhaeusser (1964).

The second phase of the remapping programme began in 1964, when the writer commenced the present study of the Jamestown and Sheba Hills area to the north of Barberton. Shortly afterwards, Messrs. M.J. and R.P. Viljoen began investigations in the Barberton belt as part of South Africa's contribution to the International Upper Mantle Project. This work entailed much remapping of the Komati River Valley - Steynsdorp areas, on the southern side of the Mountain Land, as well as the Kaapmuiden - Malelane - Hectorspruit area on the far northeastern side of the greenstone belt. Other localized remapping projects have been undertaken by Reimer (1967), who carried out a geological investigation of the Stolzburg Syncline southwest of Barberton, and Bell (1967), and Tomlinson (1967), who mapped parts of the central areas of the Mountain Land. On the Swaziland side of the Barberton greenstone belt the Geological Survey of Swaziland has also maintained a detailed mapping programme of the early Precambrian rock sequences exposed in the areas between Oshoek - Forbes Reef - Pigg's Peak, and Hhohho.

In the last six years, therefore, a large part of the Barberton Mountain Land has been carefully restudied, making available more detailed geological maps and descriptions of the area. In addition to the actual remapping, which has proved so rewarding, numerous other concurrent studies have been carried out in the area. These include researches in geochronology, carried out principally by the Bernard Price Institute for Geophysical Research, at the University of the Witwatersrand, and by the C.S.I.R. in Pretoria. Considerable interest has also been shown in the micro-palaeontological aspects of the very ancient sediments following the discovery, in them, of primitive life-forms. In addition, mineralogical and geochemical work has been carried out in some of the mines, and in some selected areas of the belt.

The resurgence of activity in the Barberton Mountain Land has thus been particularly important, not only for the local mining industry, but for the science of geology as a whole. The excellent exposure, and exceptional preservation of these very ancient rocks has proved important in allowing the formulation of concepts, and models to be made, to explain the evolution of the very early Precambrian geology.

B. LOCATION AND EXTENT OF THE AREA INVESTIGATED

The area dealt with in this report lies to the north and north-east of the town of Barberton, in the Eastern Transvaal Lowveld. Two

specific areas were mapped in detail, the first being the Eureka Syncline extending from Barberton, 9 miles north to Noordkaap and then 10 miles east towards Louw's Creek. The second area examined comprised the eastern half of the Jamestown Schist Belt, from Noordkaap in the east, to the Barberton - Nelspruit main road in the west, a distance of about 9 miles. The extent of the area covered by the detailed mapping in both the Eureka Syncline and the Jamestown Schist Belt amounts to just over 60 square miles of essentially mountainous terrain.

In addition, reconnaissance investigations were carried out along much of the northwest flank of the Barberton belt from Kaapsehoop, on the Transvaal Drakensberg Escarpment, east to Louw's Creek - a distance of about 35 miles.

The regions of the Mountain Land discussed in detail in this report lie broadly between the geographical co-ordinates 30° 45' and 31° 20' east, and between 25° 30' and 25° 47' south.

C. PHYSIOGRAPHY

The Barberton Mountain Land, as this name suggests, is essentially a rugged, mountainous, tract of country, lying immediately to the east of the younger cover of the Transvaal Drakensberg Escarpment, and occupies a wedge-shaped, triangular belt extending northeastwards from its broad base between Badplaas and Mbabane in the southwest, to its point of disappearance beneath the Lebombo Mountains on the Mozambique border near Komatipoort. Most of the area falls within the Transvaal, but the southeastern edge of the wedge straddles the Swaziland border and occupies the northwestern segment of the territory (see Figure 2, page 39). The central regions, or spine, of the Barberton Belt as a whole, attain the greatest elevations - the highest point being a quartzite peak 6,238 feet high, near the Skokohla trigonometrical beacon (6,204 feet). The elevated regions, with some exceptions, are generally comprised of sediments of the Fig Tree and Moodies Groups of the Swaziland Sequence. The Onverwacht Group of rocks has generally been somewhat less resistant and forms lower lying, yet at times, equally tugged terrain.

The Jamestown - Sheba Hills region of the Mountain Land is also very mountainous - the area being dissected by numerous deeply incised streams. The elevation varies considerably from a maximum of 3,956 feet in the Sheba Hills area to 2,200 feet - the elevation of the Consort Mine offices in the eastern part of the Jamestown Schist Belt. To the north of this belt the granite-gneiss hills of the Krokodilpoort Range form a prominent topographic area, reaching a maximum elevation, at the trigonometrical beacon Uitkyk, of 4,622 feet. On the south side of the Schist

Belt, the Kaap Valley, by contrast, forms a well-defined basin, bounded in the west by the Great Escarpment and to the south and east by the Moodies and Sheba Hills, which rise steeply from the valley floor. The general altitude of the Kaap Valley is slightly greater than 2,000 feet but rises in the west to approximately 3,500 feet.

The area north of Barberton is drained by numerous small streams which eventually form the North Kaap River, that roughly bisects the Jamestown Schist Belt, and the South Kaap River, which flows out of the Kaap Valley at a narrow outlet at Clutha Siding. Near Noordkaap these two rivers join to form the Kaap River which serves as a dividing line between the Krokodilpoort Range to the north, and the Sheba Hills to the south. Before joining the Crocodile River near Kaapmuiden the Kaap River is joined by Fig Tree Creek at Sheba Siding, Honeybird Creek near Honeybird Siding, and Louw's Creek and Revolver Creek, near Louw's Creek Station. These last-mentioned creeks drain part of the high-lying central regions of the Mountain Land and the valleys they have carved have also provided the only favourable means of access into the mountains.

D. CLIMATE AND VEGETATION

The Eastern Transvaal Lowveld has, in general, a temperate climate, but differences occur from place to place as a result of the extreme variability of the topography. The mountainous regions are considerably cooler, and have a greater average annual rainfall, than the lower lying areas surrounding the Barberton Mountain Land.

Barberton, situated in the southeastern part of the Kaap Valley at an altitude of 2,697 feet above sea-level, obtains approximately 30 inches rainfall per annum. The average annual maximum temperature is about 80°F and the minimum 60°F. July is usually the coldest month and February is often the hottest month. The most suitable period of the year for fieldwork are the months between April and October. The summer months are generally hot and humid with thunderstorms occurring regularly in the afternoons and evenings.

Apart from the unsuitable climatic conditions in the hot summer months, field mapping is made more difficult by the tall grass and dense bush that grows so profusely, particularly on the northwest flank of the Barberton Mountain Land. Exposure is greatly increased, particularly towards the end of the winter months, when the veld has either been thinned out by grazing, or by burning, just prior to the first summer rains.

Much of the area mapped as part of this study supports a dense vegetation cover. In some places, as for example in the foothills of the Krokodilpoort Range, west of the Consort Mine, the bush is so dense as to make detailed mapping on aerial photographs extremely difficult. That bush encroachment appears to be increasing at a rapid rate is clearly seen when referring to old aerial photographs of the area. Most of the hills were formerly almost completely devoid of any bush cover. Many small creeks draining the mountainous regions are now densely overgrown with trees and creepers. However, some of the elevated regions, as for example the small plateau-like platform of the Sheba Hills, still remains open and grass covered.

With the advent of forestry in the elevated central regions of the Barberton belt, as well as along the Transvaal Drakensberg Escarpment many of the small streams, that once were perennial, have now either dried up completely or only flow intermittently.

E. HISTORY AND MINING

Following the discovery of gold in 1873 in the Lydenburg-Spitskop-Pilgrim's Rest Goldfield prospectors gradually worked their way southwards along the narrow Godwan plateau of the Transvaal Drakensberg Escarpment and discovered further reefs and alluvial gold at a place known to the early hunters as the Duiwel's Kantoor. This settlement was later renamed Kaapse Hoop and it became a small township for the area which had been thrown open as public diggings.

The Kaap Valley, below the Duiwel's Kantoor escarpment was, in these early days, a very unhealthy region and was known as the Valley of Death due to the high incidence in the area, of tsetse fly, malaria, and wild animals. In 1874 Tom McLachlan ventured from the Spitskop diggings near Sabie and found traces of gold in the Kaap Valley, but these were not payable and he was driven out of the area by fever and horse-sickness. McLachlan then moved on to northwestern Swaziland where he discovered alluvial gold between Popinyana Creek and Pigg's Peak in 1881 (Pretorius, 1965A).

In 1882, a trio of resolute prospectors named Ingram James, Magnus Jeffries, and a Frenchman, Auguste Robert (French Bob) moved into the Kaap Valley from the Duiwel's Kantoor diggings and found James Murray working alluvial gold. With Murray were his partners Bob Watson and Tom Elsie, whose wife was probably the first European woman in the Kaap Valley, and whose daughter, named Nugget, was the first child to be born there (Bulpin, 1965). The discovery was worked in secret until in 1883

when another prospector, Harry Culverwell stumbled on their workings and spread the news of the find. A rush ensued and within days the camp had grown to a large settlement that became known as Jamestown, so named after the earlier discoverers' James Murray and Ingram James. Jamestown thus became the first miners' settlement in the Kaap Valley, and it had a population of about 150 people. The settlement acted as a base for most of the subsequent prospecting in the area, but as it was an extremely unhealthy place, with fever claiming many victims, its existence was short-lived.

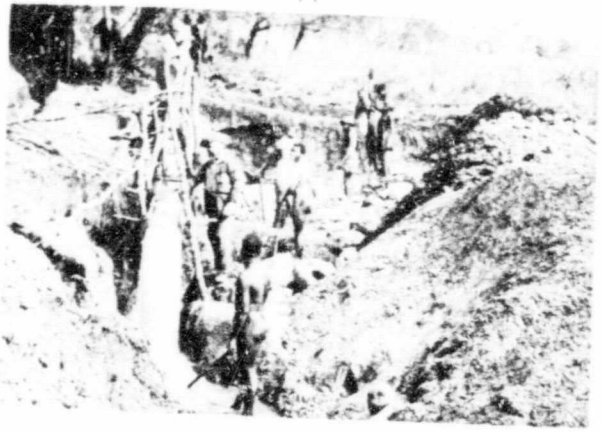
Jamestown was sited at the confluence of Kaffir Creek and the North Kaap River, the latter also being known formerly as the Lampagwana River. The settlement was situated on the north bank of the North Kaap River and it had, running through it, the Jamestown water race. The water was diverted into this canal by means of a weir situated about four miles upstream along the North Kaap River. The water was used primarily for washing alluvial gravels (Plate 1A, page 7) and for driving stamp mills such as that of the Gem Battery, near the Kaffir Creek Talc mines (Plate 1B, page 7).

The Jamestown alluvial field did not yield any great quantities of gold. The "Barberton Herald" of August 10th. 1886, reported that nuggets weighing as much as 58 ounces were found, but these appear to have been rare finds. Interest in the Jamestown area soon diminished and the prospectors moved off to higher ground across the Kaap Valley where French Bob, in May 1883, discovered alluvial gold in Concession Creek, on Moodies Estates, near Barberton. The largest nugget of gold recorded from the Barberton Goldfields was found in 1883 by George Knox. It weighed 69 ounces and was found near Dempster's Reef on Moodies Estates (Pretorius, 1965A).

Later, in June of the same year, French Bob discovered the Pioneer Reef in the Moodies Hills, the first payable reef-gold in the Barberton Mountain Land. A year later, in 1884, Graham Barber exposed Barber's Reef in Rimer's Creek in the hills south of the town of Barberton - so named after the three brothers, Graham, Fred and Harry Barber. Some old photographs depicting early Barberton are shown in Plate 2, A and B, page 9. Within a short time Barberton grew from a small camp, with only a few tents, to a large town. As news of "fabulous gold finds" filtered from the region people hastened to the scene and started one of the most spectacular gold rushes in South African history. Hundreds of reefs were found and worked, companies were formed with lavish capital, and minor discoveries were magnified beyond all reality. The first stock exchange in the Transvaal was erected in the town (Plate 2D, page 9) to cope with the feverish activity on the Goldfield.

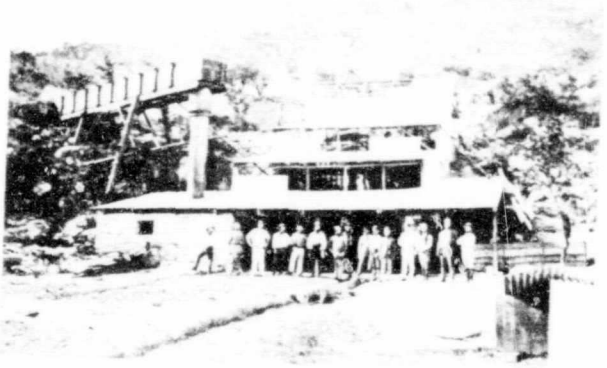
PLATE 1

A



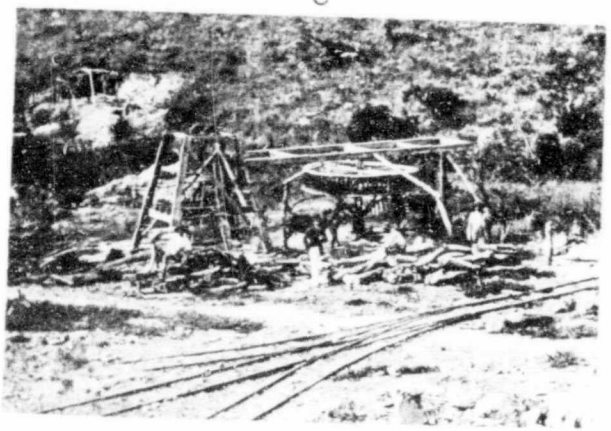
ALLUVIAL DIGGINGS NEAR JAMESTOWN
IN THE JAMESTOWN SCHIST BELT -
CIRCA 1884

B



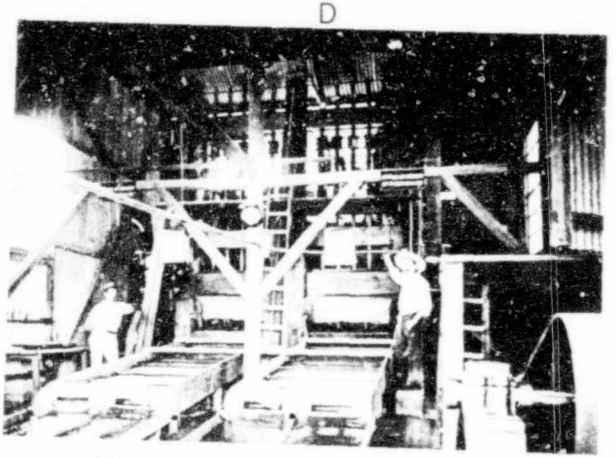
THE GEM BATTERY NEAR THE KAFFIR CREEK
TALC MINES, JAMESTOWN SCHIST BELT -
CIRCA 1890

C



THE VICTORIA GOLD MINE NEAR
CLUTHA SIDING - CIRCA 1887

D



THE INTERIOR OF THE 10 STAMP BATTERY
SITUATED AT THE CONSORT GOLD MINE -
CIRCA 1887

E

VIEW EAST DOWN SHEBA VALLEY SHOWING
THE WORKINGS AND LINES OF THE SHEBA GOLD
MINING COMPANY - CIRCA 1937

F

VIEW TODAY DOWN THE
ALMOST DESERTED VALLEY SHOWING
EDWIN BRAY'S GOLDEN QUARRY

Following the initial discoveries in the Moodies Hills area, southwest of Barberton, the next, and probably the most important, events took place in the Sheba Hills to the northeast of the town. In the Sheba Valley one of the earliest gold finds was the Nil Desperandum Reef at the head of Sheba Creek, located by Keiller (Mathers, 1887). The discovery by Edwin Bray in May, 1885 of the Sheba Reef, that eventually led to the opening up of the fabulously rich ore-body known as the Golden Quarry, marked the beginnings of a resurgence of interest and activity that was to culminate in the establishment of Eureka City.

The Sheba Gold Mining Company was formed in 1886 to work the Golden Quarry ore-body. The first mill was a 10 stamp stream battery on Fever Creek and was capable of crushing 12 to 14 tons of ore per day. Later a 20 stamp mill was installed but the water supply was insufficient and most of the milling was done along Fig Tree Creek at Charlestown, which was situated between the Royal Sheba Mine and the old Sheba cemetery, and which was the site of the crushing plants for the mines further up Sheba Valley. Charlestown's existence was short-lived, for as the tonnage of ore for the mills increased, so the water supplies became inadequate. The batteries were moved down to the Kaap River at Avoca, and Charlestown became another ghost-town.

An aerial cable-way was constructed in 1887 which ran from Fever Creek, over the mountains of the Eureka Syncline to a point near Ezzy's Pass where some of the ore was milled. The cable-way, in turn, was superceded by a tramway conceived by Lewis and Sammy Marks (Plate 2F, page 9). The tramline ran from Sheba Valley, down Fig Tree Creek, to Sheba Siding near the Kaap River.

From March, 1891, 60 stamps were in operation along the Kaap River near Sheba Siding (Bayley, 1894). Later 120 stamps were working, driven by steam and electricity, the latter generated by a hydro-electric plant on the south bank of the Kaap River. The settlement of Avoca, built to house the workers at the batteries, flourished for about five years, from 1887 to 1892. Thereafter, the companies started moving their recovery plants back on to their properties in the Sheba Valley.

Near Charlestown was situated Brays Golden Quarry battery (20 stamps), the Capetown battery, the Sheba 10 stamp battery and the Nil Desperandum 10 stamp battery. North of the old Sheba cemetery on the west bank of Fig Tree Creek was situated Rau's Mill which he later sold to Golden Quarry Deep Level Company. Near Avoca, at the junction of Fig Tree Creek and the Kaap River, were Pechey's battery and the Oriental battery. The Pearl Central Milling Company was situated on the south bank of the Kaap River somewhere near to the present Scotia Talc Mine.

PLATE 2

A

EARLY BARBERTON - CIRCA 1887

B

PILGRIM STREET, BARBERTON -
CIRCA 1887

C

EUREKA CITY NORTH OF SHEBA GOLD MINE -
CIRCA 1885

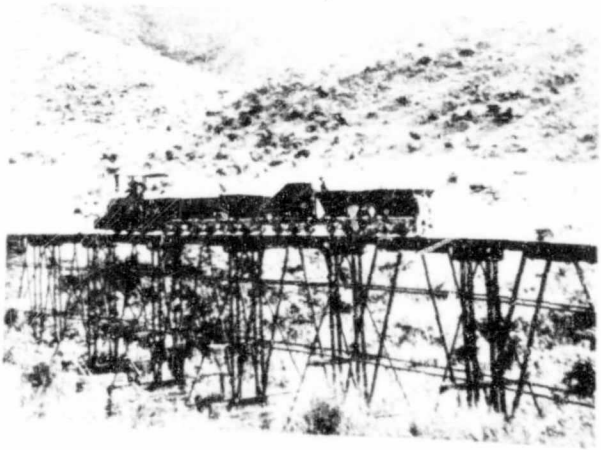
D

THE FIRST STOCK EXCHANGE
IN THE TRANSVAAL
BARBERTON - CIRCA 1885

E

SOME FEARLESS AND STALWART DIGGERS -
PIONEERS WHO HELPED TO OPEN UP THE LOWVELD

F



SHEBA TRAMWAY - FIG TREE CREEK,
1887

In December, 1885, J. Sherwood founded what was to become known as Eureka City (Plate 2C, page 9). The position of the "City" high on the Sheba Hills afforded the inhabitants protection from the dreaded malarial fever so rampant in the lower lying areas. The settlement began with the establishment of a butchery and a hotel, known firstly as the Queen of Sheba Hotel, but which later changed its name to the Central Hotel. There were soon 12 canteens, 3 hotels, a chemist shop, a police post, a bakery, and a music hall. In addition, there existed a three furlong race-course. Mathers (1887) estimated the population of Eureka City to be between 600 and 700 people, most of them being engaged in mining activities in the Sheba Valley less than a mile to the south.

The old, in places, deeply incised waggon tracks from Barberton to Eureka City can today still be seen crossing the Eureka Syncline. The 12 mile journey, taking up to two and a half hours to cover on horseback, reportedly passed as many as 27 canteens along the way.

Apart from the activities in the Sheba Valley there was considerable interest being demonstrated in the area where now is situated the Fairview Mine. Prospecting was centred about the workings of the Kidson, Blue Rock, and Equifa reefs, as well as the Victory Hill reefs. Several stamp mills were situated along the headwaters of the stream running northwards into the Golden Valley. In this valley too, there was much activity, and many were the names of properties listed by Mathers (1887), that were receiving attention but which never amounted to anything.

In time the flurry of activity died down and all but a few mines kept on operating. The settlement at Eureka City also faltered and another ghost-town resulted. Only a few ruins remain to be seen today. Restoration of the old ghost-town has recently been undertaken by members of the Barberton and Districts Publicity Association.

Practically all the mines in the Sheba Valley were eventually acquired by Eastern Transvaal Consolidated Mines Limited, Barberton, in 1937. In 1953, this company also took over the Golden Quarry and, at present, all the mines in the Sheba Valley are referred to collectively as the Sheba Mines. Plate 1, E and F, page 7 compares an early photograph of the mining installations in Sheba Valley, with the view down the same valley today. All that remain are a few scattered houses and treated dumps, and the gaping cavity of Edwin Bray's Golden Quarry on the southern slopes of the Eureka Syncline.

An aerial ropeway was constructed by E.T.C. (Ltd.) to transport ore from the Sheba workings to the mill at the New Consort Gold Mine near Noordkaap. This haulage had one angle station sited just north of the trigonometrical beacon Bar 11 on the Sheba Hills, and extended from there in a northwesterly direction, across the Eureka Syncline, to the Consort Mine, a distance of about six miles. This aerial cableway was dismantled several years ago and the milling is at present being undertaken at Sheba, with only the concentrates being sent to Consort for final treatment.

Apart from the Sheba Gold Mine, two other major gold producing mines occur in the area under review. Mention has already been made of the New Consort Gold Mine near Noordkaap, the early history of which is somewhat obscure. The mine consisted initially of several small workings, the most prominent of which were the Maid of de Kaap, Consort, Prince Consort, Queen's Consort, Shires, Ivaura, and Witkopjes mines. The writer has traced gold production figures back to as early as 1887, since which time the mine has produced gold almost uninterruptedly for the past 81 years.

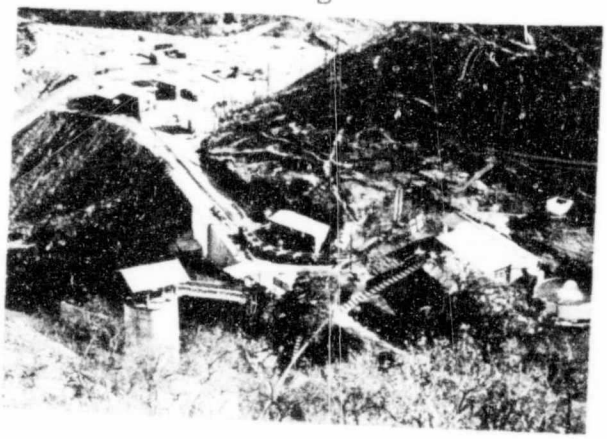
In April, 1929 the New Consort Gold Mines, Limited, were formed by an amalgamation of all the smaller properties. From a relatively small beginning the mine has accounted for the second largest production of gold in the Barberton area. Commencing initially with a 10 stamp battery (Plate 1D, page 7) the mine now mills over 170,000 tons of ore per annum and there is a roasting plant for the treatment of refractory ore. Plate 3A, page 12, shows the present layout of the Consort Gold Mine in the foothills of the Krokodilpoort Range at the eastern end of the Jamestown Schist Belt.

The other large mine in the area is the Fairview Gold Mine, situated in the Sheba Hills, at a distance of approximately 4 miles northeast of Barberton. As is the case with all the larger gold producers in the Barberton Mountain Land, the Fairview Mine also constitutes an amalgamation of a number of small properties, the names of which include the Little Kent, Kimberley-Sheba, Blue Rock, Kidson, Drummond, and Equifa workings. In 1912 Transvaal Consolidated Lands and Exploration Co. Ltd., worked the small properties until 1917, when Fairview was taken over by a company known as F.D.M. Ltd. In 1936 the property was worked by one of Barberton's pioneers, Mr. E.T.E. Andrews, and partners. They disposed of the property in 1941 to Barberton Mines (Pty.) Ltd. In 1955 Fairview Mine was acquired by Federale Mynbou Beperk. Considerable modifications and additions were made to the installations and a major development programme was instituted. The Fairview Mine is the most modernly equipped gold producer in the Barberton area at present (Plate 3B, page 12). The

PLATE 3

A

B

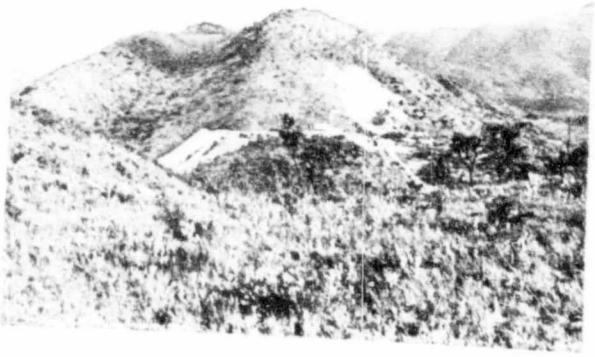


A. View looking northeast towards the New Consort Gold Mine, at the eastern end of the Jamestown Schist Belt. The hills behind the mine consist of Onverwacht Group rocks with the Nelspruit Granite terrain making up the highest regions. The Noordkaap River (foreground) flows through a potentially favourable dam site consisting of vertically dipping Moodies conglomerates and quartzites (MdQ1).

B. General view of the Fairview Gold Mine workings in Elephants Kloof. Access to the mine is afforded by an adit that extends approximately one mile northeast to the underground shaft. The ore is sent by aerial ropeway down Elephants Kloof to the mill site 2 miles away.

C

D



C. Mill site and offices of the Marbestos Mine on the Mundt's Concession differentiated ultramafic body. The offices and mill are situated on light grey-green or yellow-green serpentinite which gives rise to the chrysotile asbestos ore-body to the left of the picture.

D. General view of the Marbestos Mine showing the mine quarry and the layering of the differentiated ultramafic body. The quarry is situated on serpentinized peridotite, the ridge to the left of the quarry consists of serpentinized pyroxene peridotite, followed by meta-gabbro in the hollow and serpentinite again, on the ridge.

mine has recently become the largest single gold producer in South Africa outside the famed Witwatersrand and Orange Free State Goldfields.

Apart from the three main gold mines in the area north of Barberton there is also a chrysotile asbestos mine known as the Marbestos Mine, situated approximately two miles west of Noordkaap in the differentiated ultramafic body on Mundt's Concession (Plate 3, C and D, page 12). This mine has only been operating for about the last ten years and is owned by Marble Lime and Associated Industries. At present all the ore is quarried, there being no underground workings.

The historical aspects of the early gold boom in the Barberton Mountain Land presents a fascinating story - one which cannot adequately be presented in this report. The writer, having mapped in the areas of greatest activity of the early gold seekers, came upon many an old mine, or mill site that has lain hidden in dense bush for many years. Typical of the numerous obscure workings in the area is that of the Victoria Gold Mine, situated near Clutha Siding, approximately 8 miles north of Barberton. All that can be seen today at this old mine, which is overgrown and hidden in thick bush, are a few shafts and waste dumps. An old photograph, however, gives some indication as to the surface installations of the mine in about 1887 (Plate 1C, page 7). Other photographs such as these are available for inspection in the Barberton Museum as well as in private collections of some local inhabitants of the town. A rich historical area is unfortunately becoming clouded with time as there are few authoritative accounts dealing with the early developments in the Barberton Goldfields.

F. PREVIOUS WORK IN THE BARBERTON MOUNTAIN LAND

The earliest reference to the geology of the Barberton area dates back to Penning (1883). Numerous reports on the geology of the De Kaap Goldfields appeared during the late 1890's and early 1900's but none of them really contributed very much to the understanding of the geology of the region.

The first systematic, detailed, study of the stratigraphy, structure, and economic potential of the Barberton area was carried out by A.L. Hall, and his monumental account of the geology was published in 1918.

(a) Classification of the Stratigraphy of the Barberton Mountain Land

Hall first grouped the primitive rocks comprising the Barberton

Mountain Land into a threefold subdivision, viz :

(i) a group of extrusive rocks, mostly lavas and confined to the Komati Valley, which he named the Onverwacht Volcanic Series.

(ii) a group of sedimentary rocks, comprising both argillaceous and arenaceous types, which he designated the Moodies Series; and

(iii) a group of basic and ultrabasic rocks, presumably intrusive, which he called the Jamestown Series.

The last-mentioned group of rocks, he noted, were invaded and extensively altered by the "Older Granites" which everywhere surround the Mountain Land.

Hall's (1918) memoir remained the standard work for some time, while several other contributions to the knowledge of the area were made up to the period 1938 when the South African Geological Survey began investigations in the area. When van Eeden (1941) mapped in the Sheba Hills he found that there was an unconformity within Hall's original Moodies Series. For the succession below the unconformity, consisting of shales, greywackes, banded chert and banded ironstone, he introduced the term Fig Tree Series, and he retained the Moodies Series for the predominantly arenaceous successions above the unconformity. In 1956 the Survey's work culminated in the publication of a 1:50,000 scale geological map of the Barberton District, together with a comprehensive accompanying explanation.

In this publication (Visser, compiler, 1956) the Geological Survey regarded it necessary to revise many of Hall's views, particularly his subdivisions outlined above. A two-fold subdivision into systems was favoured, viz :

(i) the Swaziland System and

(ii) the Moodies System.

The former, and older of the two, comprised a lower succession, known as the Onverwacht Series, and an upper succession, referred to as the Fig Tree Series. The designation of Moodies System was originally proposed by Truter (1949) and was retained by Visser for the youngest of the sedimentary formations in the Mountain Land.

The Swaziland Geological Survey classification differed from that of the South African Survey in that they used the term Moodies

Series (Hunter, compiler, 1961). They make recognition of the fact that an unconformity does exist between the Moodies and earlier sedimentary formations. However, they cannot concede that the unconformity was of such significance as to warrant the separation of this series into a new System. They believe that the Moodies Series is genetically related to the remaining formations of the Swaziland System, partly because some of the successions are derived from erosion of the earlier sediments, but principally because they consider the entire Swaziland System to have been deposited in a single trough or geosyncline. They explain the unconformities that exist as being the result of local disturbances within the basin. This same classification has also been favoured in reports published by the Economic Geology Research Unit.

Hall's (1918) Jamestown Series was referred to by Visser (compiler, 1956) as the Jamestown Igneous Complex and it was suggested, furthermore, that the Kaap Valley Granite was related to this complex in much the same way that the Bushveld granite is comagmatic with the basic and ultrabasic rocks of the Bushveld Igneous Complex.

The Onverwacht rocks were long regarded as being the oldest in the area but work by Kuschke and Gribnitz et al, (1961) cast doubt on this interpretation. It was suggested that another series, lying below the Onverwacht, should be established. To this series Gribnitz gave the name Oorchot, from the farm where Kuschke first noted that rocks, mapped as Jamestown Complex, consisted of dolomite and arenaceous varieties with interbedded banded cherts, ironstones, carbonate-bearing shales and a conglomerate horizon. Gribnitz et al, (1961) contended that subsequent kinemetamorphic influences converted large portions of the carbonate-bearing rocks into talc-carbonate and quartz-sericite schists, various occurrences of which had previously been placed into the Onverwacht and/or Fig Tree Series, as well as into the Jamestown Complex.

Such was the position when detailed mapping of the Barberton Mountain Land was recommenced by members of the Economic Geology Research Unit of the University of the Witwatersrand, Johannesburg, in 1961. It soon became apparent, in areas along the northwestern flank of the Barberton belt, that the classification proposed by the Geological Survey (Visser, compiler, 1956) was untenable, and required further revision. As mentioned above, the Survey classification had already been challenged by Gribnitz et al, (1961) and it was not long afterwards that further workers in the area came up in support of the need for revision of the classification existing at the time. (Herget, 1963; Anhaeusser, 1964; van Vuuren, 1964; Viljoen, 1964; Cooke, 1965; Steyn, 1965).

The general concensus of opinion of these investigators was, that the base of the Swaziland System consisted of a stratiform sequence

of altered basic and acid lavas, and sediments, of pre-Fig Tree age. At that stage it was still debatable whether such pre-Fig Tree rocks belonged to the established Onverwacht Series, the lower portion of the Fig Tree Series, or to a previously unrecognized group such as the Oorschot Series, suggested by Gribnitz et al, (1961).

It was, however, generally agreed among the investigators, that the base of the Swaziland System was not represented by intrusive Jamestown rocks belonging to the end-phase of the formational cycle, but consisted of extrusive and sedimentary pre-Fig Tree rocks, formed during the initial stages of development of the Barberton greenstone belt. The need for the reassessment of the stratigraphic column of the entire Barberton Mountain Land was, therefore, firmly advocated by Anhaeusser and Viljoen (1965).

Strong opposition to any change in the existing classification was received from the South African Geological Survey and for a long period much confusion existed because of the conflicting views of the Survey and the investigators associated with the Economic Geology Research Unit.

With the establishment of a programme of study associated with the International Upper Mantle Project, M.J. and R.P. Viljoen, in August, 1965 began mapping in the Komati River Valley, on the southwestern side of the Mountain Land. From the outset, their remapping once again stirred up the Jamestown controversy, as they too, could not find evidence to support the continued existence of the Jamestown Complex as envisaged by the Geological Survey. The reader is referred to a comprehensive account of the previous views regarding the stratigraphy of the Onverwacht Series by Viljoen and Viljoen (1967). In this paper are reviewed the previous ideas regarding the Onverwacht Series, the so-called Jamestown Series of Hall, (1918) and the Jamestown Igneous Complex of the Geological Survey (Visser, compiler, 1956).

Across the border, in northwestern Swaziland, the Swaziland Geological Survey also began to accumulate evidence questioning their early official classification (Hunter, compiler, 1961) which, for the most part, was identical to that of the South African Geological Survey. Urie and Jones, two Swaziland Survey geologists, have recently remapped much of the Swaziland System in northwestern Swaziland. Urie (personal communication, 1968) has re-examined much of the Motshane and Forbes Reef area and has concluded that Hunter's (1961) lower Fig Tree Series, and much of what was previously mapped as Jamestown Complex is, indeed, Onverwacht basic and ultrabasic lava, with narrow interbedded sedimentary horizons. Likewise, Jones (personal communication, 1968),

who has been engaged in remapping the Pigg's Peak-Hhohho area of Swaziland, has also confirmed the widespread existence of Onverwacht assemblages at the expense of what were formerly regarded as Jamestown rocks.

With disagreement still taking place in South Africa it was decided to set up a Steering Committee that would visit many of the areas in the Barberton Mountain Land that were considered to be pertinent to the problems concerning the relative age, origin, classification, and distribution, of the mafic and ultramafic rock units, and the relationship of the Kaap Valley Granite to these rocks. A report on the findings of the Upper Mantle Steering Committee was drawn up (Ferguson, co-ordinator; 1967) in which it was stated that "it soon became evident that a large portion of mafic rocks, previously regarded as intrusive and so belonging to the Jamestown Igneous Complex (Geological Survey classification), contained primary structures which indicated their extrusive origin, necessitating therefore, inclusion in the Onverwacht Series. This was particularly applicable to the areas in the southwest of the Mountain Land (Tjakastad District), the Jamestown Schist Belt, and the rocks chiefly to the north of the main road from Kaapmuiden to Hectorspruit".

The Steering Committee, furthermore, "decided to rename the Jamestown Igneous Complex as the Jamestown Igneous Suite". This provision was acceded to because of the existence, in the Barberton greenstone belt, of several masses of intrusive, predominantly ultramafic rock, but also containing minor mafic units, that show no typical lava structures and have all the characters of intrusive rocks. These masses are typified by the rhythmically layered bodies, such as the Handsup-Mundt's Concession, Malelane-Kaapmuiden, and Stolzburg ultramafic bodies, to name but a few. In the report (Ferguson, co-ordinator; 1967) it was stated that "with the exception of the large granitic bodies, all igneous rocks of an intrusive or unknown origin, occurring in the Onverwacht, Fig Tree or Moodies Series (System ?) will be incorporated in the Jamestown Igneous Suite". Furthermore, the Committee agreed "that if individual workers on the problem could present sufficiently good arguments to show that certain ultramafics were intimately related to the effusive mafic rocks, they should be free to include them in the Onverwacht Series".

The writer has quoted extensively from the report on the findings of the Upper Mantle Steering Committee primarily because these findings have never been made generally known, and many papers and reports still appear with the old nomenclature, merely because the views of Visser (compiler, 1956) have never officially been rescinded.

Further modifications to the classification scheme of the Swaziland System stratigraphic column were proposed by Steyn (1965) who suggested the elevation of both the Onverwacht and Fig Tree Series to the

status of Systems, and these, together with the Moodies System, would embrace the Swaziland Complex. Because the Fig Tree successions constitute "a lower, carbonate-rich division of foliated, and partly silicified, calcareous rocks which are so characteristic and lithologically dissimilar to the conformably overlying, rather ferruginous, unaltered upper division of shale, greywacke and chert", Steyn (1965) proposed that the Fig Tree System be divided into a lower division, which he called the Zwartkoppie Series, and an upper division, which he designated the Sheba Series.

As the remapping programme in the Barberton belt continued Viljoen and Viljoen (1967) proposed a new threefold stratigraphic subdivision of the Onverwacht Series in the Komati River Valley, in the southwestern portion of the Barberton Mountain Land. The subdivision, into three stages, was based on distinctive rock-types and associations. The Lower Onverwacht or Theespruit Stage, constituted a sequence of metabasalts with numerous, thin, interlayered, siliceous, sedimentary horizons, and several interlayered ultrabasic bands. The Middle Onverwacht or Komati River Stage, included alternating pillow basalts and ultrabasic bands, and the Upper Onverwacht or Hooggenoeg Stage, consisted essentially of basalts and andesites, as well as distinctive, interlayered, thin, horizons of more acidic lava and chert bands.

Using this threefold subdivision of the Onverwacht Series, which emerged from the work in the Komati Valley, Anhaeusser, Viljoen and Viljoen (1966) attempted a regional correlation of the pre-Fig Tree rocks elsewhere in the Barberton Mountain Land. These authors stated that "detailed mapping in the southern and northern portions of the Mountain Land has indicated that it is possible to correlate with confidence the pre-Fig Tree successions of the Swaziland System. Reconnaissance surveys as well as a review of available literature has shown that this correlation is valid for most pre-Fig Tree rocks forming the periphery of the Barberton Mountain Land".

Continued mapping in the Komati Valley between Badplaas and Steynsdorp showed that the threefold subdivision, proposed earlier, was suitable only in a very general way and that refinement was necessary to account for the variations that occurred in the volcanic pile which was indicating an uninterrupted thickness approaching 50,000 feet.

It became evident that the Onverwacht Series, as developed in the Komati Valley area, was comprised of a number of units, the upper group of which did not appear to be developed anywhere else in the Barberton belt.

The most recent and, hopefully, the final classification scheme of the Onverwacht assemblage is as follows (Viljoen and Viljoen, manuscript in preparation, 1968) :

(i) the Sandspruit Formation, at the base, consisting predominantly of ultramafic rocks (60-70 per cent) with the remainder comprising mafic rocks and very minor and primitive sedimentary horizons.

(ii) the Theespruit Formation, comprising mainly mafic volcanic rocks, together with water-worked salic tuffs, and some talc-chlorite-carbonate schists and other minor ultramafic horizons.

(iii) the Komati Formation, consisting predominantly of mafic volcanic rocks (70 per cent) and ultramafic rocks, some volcanic (30 per cent). Siliceous rocks are entirely lacking from this Formation, but intrusive quartz and felspar porphyries are present.

(iv) the Hooggenoeg Formation, consisting of a number of cycles of basic lava, acid lava, and chert.

(v) the Kromberg Formation, comprising, once again, basic lava, acid lava, and chert, but having, in addition, a wide variety of pyroclastic volcanic rocks as well as calc-silicate and carbonate rocks, and finally,

(vi) the Zwartkoppie Formation (formerly the lower part of the Fig Tree Series), consisting of cherts, intermediate lavas, a wide variety of schists and possibly some greywackes.

The lower three formations are thus composed essentially of mafic and ultramafic rocks, while the upper three formations are comprised of mafic and more acid volcanics together with a wide variety of siliceous and pyroclastic rocks. The six-fold subdivision of the Onverwacht Group is, once again, based on distinctive rock-types and rock-assemblages.

Note: It has recently been decided by most workers engaged in the re-mapping of the Barberton Mountain Land to abandon the use of chrono-stratigraphic units (System, Series, Stage), which terms imply time-equivalence of stratigraphic units throughout their area of development. The present system of stratigraphic nomenclature appears due for extensive revision in South Africa and papers expressing the need for litho-stratigraphic subdivision in South African stratigraphy have recently appeared (Truswell, 1967; Newton, 1967). The 1961 Code of the American Commission of Stratigraphic Nomenclature (Krumbein and Sloss, 1963) has