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MAP.

The Witwatersrand System.



by

W. E. Bleloch.



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# The Witwatersrand System.

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by

W. E. Bleloch.



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WITWATERSRAND



# The Witwatersrand System.

By W. E. Bleloch.

Author of "The New South Africa."

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An Explanatory Treatise to accompany a Geological Map of  
a Portion of the Southern Transvaal and a Portion of the  
Northern Orange Free State, Illustrating a New Reading  
of the Geology of the Witwatersrand System in these Areas.

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Published at 2 & 3, Transvaal Bank Buildings,  
Fox Street, Johannesburg.

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Treatise and Map	-	-	-	-	-	£3	3	0
Treatise alone	-	-	-	-	-	0	5	0





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## AUTHOR'S NOTE.

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The author wishes to state that the ideas set out in the treatise are the result of careful study extending over many years, and are built up from a great number of new facts observed during the past decade. Many of these new facts are referred to in the treatise.

He desires formally to withdraw any old ideas published by him some years ago which are in conflict with the new.

In 1903 Mr. Julius Kunst was right in placing the Buffelsdoorn beds in the Klerksdorp area among the Lower Witwatersrand beds, and he (the author) was wrong in classing them as Elsburg. The truth is now evident, that the beds in question are the Langermannskop or South Rietfontein Beds. The author, however, can claim, at that time, to have correlated successfully and correctly the beds exposed in the Klerksdorp area from the Granite to the Hospital Hill Series with the beds of the same horizon on the Rand. His error in correlating the beds immediately overlying the Hospital Hill Quartzites in the Klerksdorp area with the Main Reef Series of the Central Rand, is, after all, the same error which has been made by several eminent Geologists, including Mr. Kunst, in correlating the Van Ryn Series of the Far East Rand and the overlying beds with the Main Reef Series and the Kimberley Series of the Central Rand. In both cases the beds thus wrongly correlated belong to the Rietfontein and South Rietfontein Series of the Central Rand.

The author trusts that the new ideas will be considered on their merits and hopes their publication will stimulate interest in what must be admitted to be a matter of national importance, namely:—The location of further extensions of the Banket Reefs which support the Gold Mining Industry of the Rand.

JOHANNESBURG,

*September 14th, 1910.*



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## About the Map the following notes are required:—

### NOTE 1.

While the greatest care has been taken in the compilation of this map, it is of course impossible to guarantee absolute accuracy in every detail.

There may, for instance, be some small outliers of coal measures not marked, and the delimitation of the unconformable formations overlying the Witwatersrand System may be slightly out here and there, yet it can be fairly claimed that in the main they are as nearly right as they can be made short of an actual survey.

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### NOTE 2.

#### *The Red Bar of the Main Reef Series.*

In regard to the colouring of the Main Reef Series (Red on the Map) it must be understood that the Shale bed represented by the brown line appearing at the margin of the series, between the red of the Main Reef Series and the blue of the Market Square-Fairview Series lies at some considerable distance from the Main Reef itself. The intervening beds are chiefly red or purple Sandstones or Grits. The upper part of these, nearest to the Main Reef, constitute the well-known "Red Bar" of the Main Reef Series, which was the guide or marker used by the early prospectors of the Rand when locating the outcrops of the Main Reef Series. The average thickness of these beds, which intervene between the Main Reef and this first underlying body of Shale, is about 900 feet. The thickness varies from about 700 feet to about 1,000 feet. At the Simmer and Jack the red bar and its associate beds are about 850 feet thick; at Mayfair they are about the same; at Roodepoort they are a little over 1,000 feet; at the West Rand Consolidated, west of Krugersdorp, about 900 feet; at Porges they are about 800 feet. So that the actual position of the Main Reef may be taken as about 900 feet (geologically speaking) above the Shale bed depicted on the Map, coloured brown, bordering between the red of the Main Reef Series and the blue of the Market Square-Fairview Series.

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### NOTE 3.

#### *The Black Reef.*

The Black Reef Series and the Dolomite are shown together in black and white on the Map. The position of the Black Reef itself is near the base of the series, and its position is approximately marked by the Black line on the margin of the Black Reef-Dolomite formation, as shown on the Map.

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### *Errata.*

#### (1)

Through an error in printing the black and white on the Map, there is a small area west of the farms Kromkuil, Van Staden's Drift, and Roodewal, in the Vredefort District, showing Witwatersrand beds uncovered. The area referred to is covered with Coal Measures and Amygdaloidal Diabase. There are no surface outcrops of the Witwatersrand beds depicted in the small area referred to.



(2)

The northern end of the line of Section C—D should have been marked in the Map slightly to the East of where it is placed on the Map.

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(3)

The Brown line which should have represented the shales at the base of the Langermann's Kop or South Reitfontein Series (so called Kimberley Shales of the Far East Rand) has through an oversight been omitted from the section G.H. See position of the Shale bed referred to on the Map in the area traversed by the line of section.



## CHAPTER I.

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### INTRODUCTORY.

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Since the discovery of the gold-bearing banket beds of the Rand in 1886, the geology of the Witwatersrand has been treated comprehensively and in detail by many authors. In 1895 the Geological Society of South Africa was founded, and in the early papers read before that society the main features of the systems existing in the Southern Transvaal were described, and it may be said that the conclusions then arrived at were in the main generally accepted.

The chief outstanding deductions then drawn from the observed facts were:—That the outcrops of the Witwatersrand rocks represent the upturned edges of a vast succession of beds of sedimentary origin, which had been curved into anticlinal and synclinal folds. That the anticlinal fold bending over the Witwatersrand northwards had been caused by the intrusion of the great granite mass which lies exposed between Johannesburg and Pretoria. That the crest of the anticlinal fold had been worn away by erosion, leaving the various strata of the Witwatersrand sedimentary formation exposed on the southern limb of the anticline, the northern limb being covered by more recent formations; the present surface on the south of the granite consequently forming a plane of exposure or section of the various strata making up the formation.

In the present treatise it will be explained:—

That the idea of the granite being intrusive in the Witwatersrand beds and possibly the cause of the anticlinal folding is no longer accepted. Evidence will be brought forward showing that the granite existed before the sedimentary beds were deposited, and that the granite itself was affected by the same earth movements which caused the folding of the Witwatersrand system.

Further, the early ideas implied that later rocks—those of the Vaal River and Transvaal systems—were also affected by the movements which were supposed to have been caused by the intrusion of the granite mass. Evidence will be adduced to show that the main folding of the Witwatersrand beds took place prior to the deposition of the Vaal River system, and that severe and prolonged erosion also took place before the deposition of that system.

New facts have been observed about the actual geographical and stratigraphical position of the individual strata of the Witwatersrand system, and the material bearing of these new facts on the tectonics of the Witwatersrand area will be explained.



*Two Payable Series instead of One.*

The conclusions which have resulted from a study of these new facts will, if they prove to be correct, be of the greatest importance economically as well as scientifically, as they point to the existence in the Witwatersrand system of two widely separated Banket Reef Series containing payable gold, whereas by the old reading only one was recognised, and, further, they indicate that while both series are at present being worked on a large scale, in different areas, under the assumption that they are one and the same, in the immediate future, providing the new reading is correct, the real extensions of both payable series may be confidently expected to be discovered at easily workable depths, and at comparatively little cost, thereby adding immeasurably to the magnitude and life of the gold mining industry of the Transvaal.

It must be remembered that although the early idea of the granite being intrusive in the Witwatersrand System is no longer held, and instead it is now accepted that the granite belongs to the Archaean system, and constituted part of the floor on which the Witwatersrand sedimentary beds were deposited, some of the leading geologists have accepted the other early conclusions, and in a general way the main body of Rand opinion is more or less in favour of the ideas about the order and the correlation of the Witwatersrand beds which were then and are at present generally accepted, and consequently may at first be opposed to the new reading explained in this treatise. If the new reading proves to be correct, it is regrettable that in the case of several important companies with large capital operating on the East Rand, a line of country has been selected by the various managements and their consulting engineers which contains neither of the proved payable series of the Witwatersrand, but a series which, so far, has not yet been proved payable at other places. The development of the mines in question in each case appears to disclose unsatisfactory values over large areas and payable values over smaller areas only.

Before entering on the description of the Rand area in detail, it will be useful to set down in schedule form the order and sequence of the geological systems as they exist in the Southern Transvaal and the North of the Orange Free State.

GEOLOGICAL SYSTEMS.

System.		Rocks.	Localities.
(1) The Lower Karoo System			
Coal Measures	...	Sandstones Shales and Coal Beds	Far East Rand, South East of Heidelberg, Vereeniging, Vierfontein
Ecca Shales	.. ...	Shales	
Dwyka Conglomerate	...	Glacial Conglomerates	
<i>Unconformity.</i>			
(2) The Transvaal System (Molengraaff)			



System.	Rocks.	Localities.
The Pretoria or Gatsrand Series ... ..	Quartzites, Shales and intrusive and interbedded igneous rocks	Pretoria Gatsrand
The Dolomite Series ...	Blue Magnesian Limestones cherts and Manganiferous Shales	The Rand Heidelberg Potchefstroom Klerksdorp
The Black Reef Series	Quartzites, Shales and Conglomerate Beds (gold bearing)	
<i>Unconformity.</i>		
(3) The Vaal River or Ventersdorp System		
Klipriversberg Diabase	Amygdaloidal Diabase, Shales, Quartzites (conglomerates) and Boulder Beds	The Rand Heidelberg Potchefstroom Klerksdorp Ventersdorp
Ventersdorp Beds ...		
<i>Unconformity.</i>		
(4) The Witwatersrand System		
The Elsburg Series ...	Quartzites, Shales and Conglomerate Beds (gold bearing) with interbedded igneous sheets and intrusive dykes. (On the Rand, all the beds from the Elsberg to Orange Grove inclusive)	The Rand Heidelberg
The Kimberley Series...		
The Bird Reef Series ...		Venterskroon
The Main Reef Series...		
Market Square-Fairview Series ... ..		Klerksdorp
South Rietfontein Series		
Rietfontein—Van Ryn Nigel Series ...		
Hospital Hill Series ...		
Yeoville Series ..		
Orange Grove Series ...		
<i>Unconformity.</i>		
(5) Archaean System ...	Old Granite and Schists	North of the Witwatersrand East of the Nigel South east of Heidelberg Vredefort West and North West of Buffelsdorn



The Witwatersrand system has hitherto been divided into two divisions, upper and lower. The upper, including the Main Reef Series of Conglomerates and all overlying beds, and the lower, including all the beds underlying the Main Reef Series to the granite.

The upper Witwatersrand beds have been described as chiefly Quartzites and Conglomerates; the lower Witwatersrand beds as chiefly Quartzites and Shales. In this treatise this division of the system into two is not accepted, nor is the description of the lower beds. It is shown that there are many important Banket Reef series in what are at present classed as the lower beds or Quartzite-Shale Group.

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## CHAPTER II.

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### THE WITWATERSRAND SYSTEM.

#### THE OLD AND THE NEW GEOLOGY.

The Witwatersrand proper may be said to extend from Randfontein on the west to Boksburg on the east. Beyond Randfontein the sedimentary rocks of the Witwatersrand system trend to the southwest, and are lost to view successively under the beds of the Vaal River and Transvaal systems, on the farms Luipaard's Vlei, Middel Vlei, Gemsbokfontein and Venterspost. Eastwards of Boksburg the upper beds are also submerged beneath newer and unconformable beds belonging to the Karroo, Transvaal and Vaal River systems. It is owing chiefly to the extensions eastwards and westwards of the Witwatersrand rocks being covered in the manner described above, that the failure to locate the extensions of the beds of economic value is probably due. More especially is this so on the East Rand. The views about to be enunciated are that the Main Reef Series of the Central Rand proper has not hitherto been discovered nor developed beyond Boksburg on the east nor beyond the South Randfontein Deep property on the west. The Kleinfontein, Van Ryn, Modderfontein and other Far East Rand Companies, are working much older beds, which belong to one and the same series, viz., that which is worked at Rietfontein, although variously known in different localities as the Rietfontein, Van Ryn and Nigel Series. These beds from the Kleinfontein property eastwards have, according to the geology of the past, been classed as belonging to the Main Reef Series, that is to say, from the point where the beds of the Karroo system obscure the outcrop of the Main Reef Series at Boksburg, the true line of the Main Reef Series has been departed from, and a jump has been made over the intervening beds, and the Van Ryn beds have been considered to be the extension of the Main Reef Series, whereas they really belong to the much older Rietfontein Series.

#### *How the Old Geology was Built Up.*

In order to let the new ideas be clearly understood, it will be necessary to describe briefly the grounds on which the geology of the past has been built up. Taking a cross section from Orange Grove north of Johannesburg through the townships of Bertrams, Troyville and Jeppestown, to the Elsburg Series, the following succession of beds is to be seen:—



## A.—ARCHAEAN SYSTEM.

Granite. (*Coloured orange on map.*)

## B.—WITWATERSRAND SYSTEM.

1. Orange Grove Quartzites and basal Conglomerates. (*Coloured yellow on map.*)

2. Yeoville Beds:—Black and Red Shales, some Quartzites, including one band known as the Ripple Marked Quartzite. The Shales are in places banded and contorted, and in some localities have been mistaken for the shales in the succeeding Hospital Hill series No. 3. (*Coloured dark brown on map.*)

3. Hospital Hill Series, comprising: A small layer of Quartzite containing fragments of felspar (Speckled Bed) succeeded by a wide band of ferruginous shales, banded and contorted (Hospital Hill Shales). A wide series of Quartzites often green in colour and with sago structure (Hospital Hill Quartzites). (*Coloured, Shales dark brown, Quartzites green on map. The speckled bed being narrow, is not shown in colour.*)

4. Rietfontein or Van Ryn Series, comprising: Red and olive green Shales and White Quartzites, Rietfontein or Van Ryn Bankets and Quartzites (the horizon of these beds is partly covered in this area by surface soil and diabase belonging to the Ventersdorp system. They are, however, in evidence a little to the east of the line of section. (*Coloured, Shales brown, Bankets and Quartzites pink, on map.*)

5. Langermannskop or South Rietfontein Series, comprising: Olive green shales succeeded by a large series of sericitic Quartzites and large and small pebble Bankets (South Rietfontein or Langermannskop Reefs. So-called Kimberley series of the Far East Rand.) (*Coloured, Shales brown, Bankets and Quartzites pink, on map.*)

6. Market Square—Fairview Series, comprising: Speckled Quartzite, striped contorted Shales, and a succession of beds of Quartzite interstratified with smaller beds of Shale, there are Bankets at the base of the Quartzites near the striped Shales, and there are Bankets immediately overlying the Quartzites followed by red Shale. (Government Reef Series of West Rand). These beds in this section have hitherto been mistaken for those of the Hospital Hill Series No. 4 (*Coloured, Shales dark brown, Quartzites blue, on map. The speckled bed is not shown in colour.*)

7. Main Reef Series: Dark red Sandstones and Banket Beds, then pink and white Sandstones. (*Coloured red on map.*)

8. Bird Reef Series of Bankets and Quartzites. Overlying these is a Shale bed known in the Central Rand as the Bird Reef Marker. (*Coloured, Bankets and Quartzites red, Shale brown, on map.*)

9. Kimberley Series of Quartzites and Banket Beds. At the base of these there is an important Shale Bed (Kimberley Shales). (*Coloured, Shales brown, Bankets and Quartzites red, on map.*)

10. Elsburg Series of Quartzites, Sandstones, and large and small pebble Bankets. (*Coloured buff on map.*)

These complete the series of the Witwatersrand system visible at the present surface in the area. There follows unconformably the Amygdaloidal Diabase belonging to the Ventersdorp system.



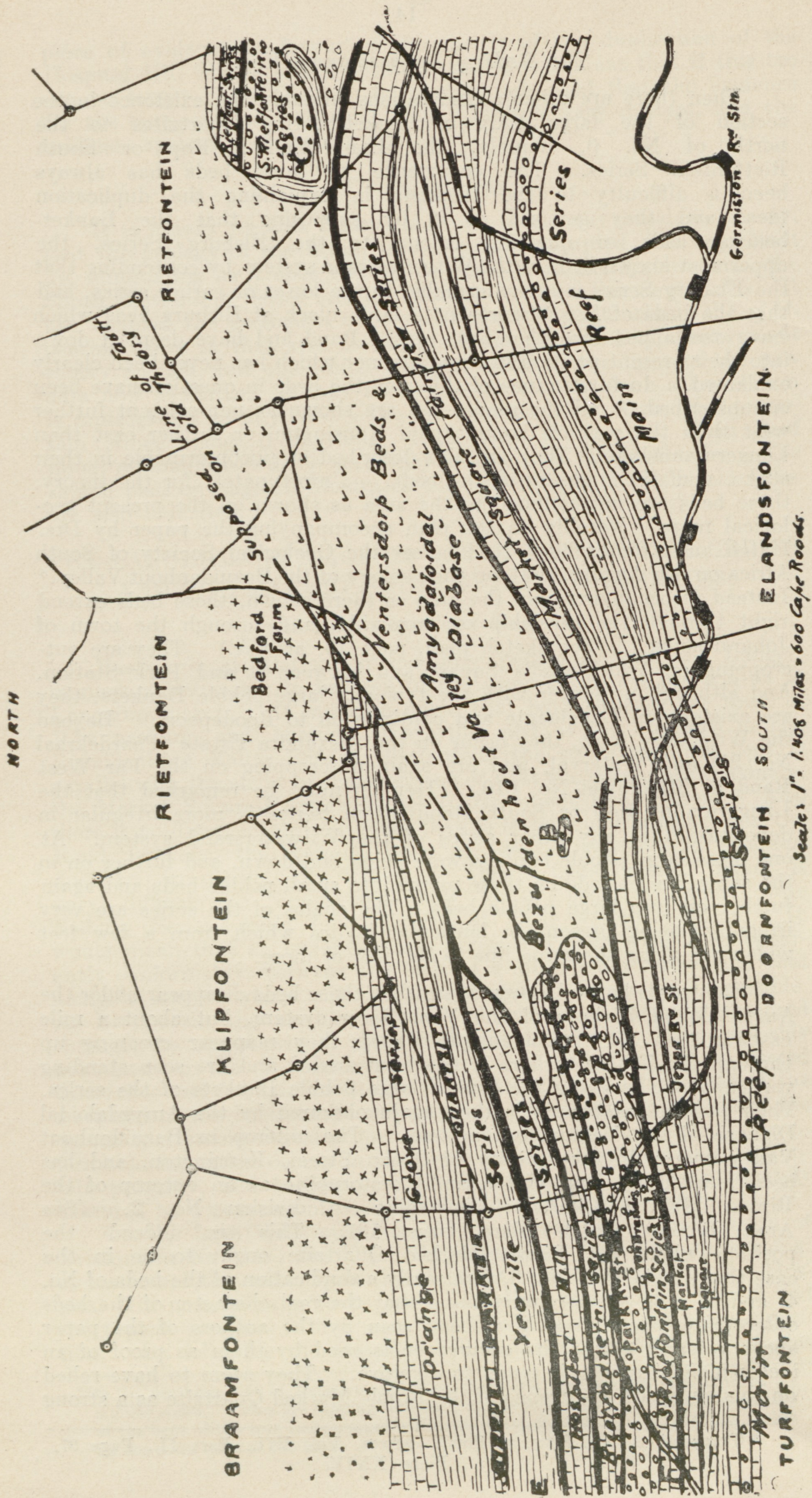
*The Market Square—Fairview Series and the Hospital Hill Series.*

The reading of the geology of this area, which has so far been generally accepted, identifies No. 6 series with No. 4, and its presence twice in the section is explained by imagining a transverse fault to exist running from Bedford Farm south-west by west through the Bezuidenhout Valley. This fault is supposed to have caused a duplication of No. 4, that is the Hospital Hill Shales and Hospital Hill Quartzites. The northern line terminating in the Bezuidenhout Valley on the east and the southern line at Jeppes Station on the west (see sketch plan, page 13). The main reason for this deduction is the presence in both Nos. 4 and 6 of a small bed of speckled Quartzite lying in the same relative position below the Shales in each case. The speckled Quartzites in question owe their speckled appearance to cavities on the surface of the rock and yellow or pink specks in the rock derived through the decomposition of fragments of felspar, which have evidently constituted part of the material of which the beds were made up.

*The Data Reviewed.*

The coincidence of similarity of composition in both speckled beds, as also the similarity of the sequence of stratification is, it must be admitted, very remarkable, and the deduction that No. 6 is a duplication of No. 4 appears at first sight to be warranted. But on further consideration grave doubts arise about the theory, and it becomes evident that a simpler and evidently more correct way to account for the facts is to accept that the similarity is merely a coincidence, and that the speckled bed of No. 6 is merely a layer of Quartzite containing felspar fragments, which was laid down under similar conditions to those which produced that in No. 4, and that it happened to be followed by similar layers of mud to those which followed in No. 4, and that No. 4 is not cut off by the supposed fault, but its continuation eastwards is merely obscured by the rocks of the unconformable Ventersdorp system. The first main objection to the fault and duplication theory is that the overlying beds, Main Reef Series and others, are continuous and unaffected by any great faulting. This is explained away by the theorists by supposing that the direction of the fault changes, and it becomes a strike fault before it reaches the Main Reef horizon. Then there is the question of the sago structure of the Quartzites overlying the striped Shales in both No. 4 and No. 6. On examination it is found that this structure may be called typical of the Quartzites of No. 4, and only partially typical of those of No. 6, and inasmuch as other Quartzites of the Witwatersrand system have this same sago structure, it cannot be relied upon as a definite characteristic; further, the Quartzites of No. 6 are interstratified by small beds of Shale, and no similar beds of Shale are in evidence between the real Hospital Hill Quartzites in this section. There is also the occurrence of a thin but large pebbled bed of Banket and two overlying leaders (Government Reef) at the base of the Quartzites of No. 6, while no such bankets are to be seen in No. 4. Then these beds of No. 6 are represented as stopping short at Jeppes Station, whereas they continue right through Johannesburg. They outcrop on the Market Square, and continue through Langlaagte, as also do the underlying striped and occasionally contorted Shales and the speckled bed of the series. These Shales can be seen outcropping in President and Pritchard Streets, and there is an outcrop of the whole series and the speckled bed at Mayfair. This fact alone goes far to upset the fault-duplication theory as the supposed identity of the two speckled beds is the chief corner stone on which the theory is built, and once it is removed the whole structure falls to the ground.





Scale: 1" = 1.408 Miles = 600 Cape Roads.



*The Beds of Langermann's Kop.*

Then there are other considerations, notably the existence in the section of the large body of banket-bearing Quartzites to the north of No. 6, namely, the Langermann's Kop or South Rietfontein Series. The occurrence of these beds has always been a difficulty to the theorists in explaining the duplication idea, and they get rid of it by supposing that the Banket-bearing beds in question belong to the Elsburg Series, the uppermost known beds of the Witwatersrand system, by contending that the Elsburg Series is unconformable to the lower or earlier series, and that the beds of No. 5 represent a large block of Elsburg beds which have overlapped the other beds of the Rand and have dropped down into their present position in some manner which has never been clearly explained. In furtherance of this idea the beds in question have been circumscribed on all the plans, and are shown as non-existent further west than the western boundary of Kensington or further east than Langermannskop. They are also described as unconformable in their strike, and dip to the overlying beds. Unfortunately for the theory, these beds are not confined to the area as shown on the present geological maps. Notably on the plan accompanying the paper by Drs. Hatch and Corstorphine, read before the Geological Society of South Africa on 8th August, 1904, on the geology of the Bezuidenhout Valley.\* Instead of occupying only the area as there shown, these beds extend right through the township of Troyeville, and through the town of Johannesburg. (See sketch plan, page 13, area A.) They are outcropping on Von Brandis Square and between it and Park Station. And although no longer with the typically large pebble Bankets, they are existent on Langlaagte and continue on to Roodepoort. Beyond the Witpoortje fault, they occur on the Alexandra Estate (Paardekraal No. 25) and Waterval, and are again outcropping on the Far West Rand at Middlelei No. 610. Here it must be remarked that the Langermanns Kop or South Randfontein Series is more irregular in deposition than any other series of the Witwatersrand system. At one place large pebble bankets were being laid down, and further on in the same line of bedding these merge into small pebble beds and again further on into large pebble beds. The shales of the series are very irregular, being present in lenticular bodies which from a few feet widen out along the same line to 500 feet or more.

Eastwards beyond Langermannskop these beds disappear under the Amygdaloidal Diabase of the Vaal River system, but about a mile eastwards in the Bezuidenhout Valley, they reappear cropping up through the Diabase where it has been eroded and are seen standing vertically and showing the typical large pebble Bankets of the series. Their position eastwards is then again obscured by the Amygdaloidal Diabase of the Ventersdorp system. The outcrop in Bezuidenhout Valley occurs in the vicinity of Ocean Street, Kensington, and has been marked by Drs. Hatch and Corstorphine as an outcrop of the Ripple Marked Quartzite, belonging to division No. 2. (See Area B on sketch plan, page 13). This is indeed the position where the Ripple Marked Quartzite ought to be in the case that the beds of No. 6 were really a duplication of the beds of No. 4, and it is an extraordinary thing that the real character of the beds outcropping should not have been seen by the authors of the paper above referred to, as the occurrence is used by them as proof of an idea which in reality it tends to disprove. They seem to have relied on this supposed occurrence of the Ripple Marked Quartzite as a strong

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\* Transactions Geo. Socy. of South Africa, Vol. VII., Part II., Page 97, Plate XXIV.



piece of evidence in favour of the theory of the duplication of the Hospital Hill Shales and Quartzites, and it is evident that if this too can no longer be relied upon it must be admitted that the evidence for the supposed Bezuidenhout Valley fault is very meagre, and the evidence against it overwhelming.

### *A Faulty Geology.*

It is chiefly on this faulty, and one might say baseless, theory, that the geology of the Rand, now generally accepted, has been built up, eliminating as it does two whole series from the system, viz., the South Rietfontein Series and the Market Square—Fairview Series. It has enabled the geologists of the Far East Rand to claim the gold-bearing series in that area to be true Main Reef Series, a convenient theory enough, but one which will not stand in the light of the new data now available. It may further be stated that such a correlation is unnecessary in any case. The Kleinfontein, Van Ryn, Modderfontein Mines being, if anything, richer than the average Main Reef mine, although as will be seen they belong to a different series. The sketch plan on page 13 illustrates the new reading, and the old ideas are also indicated.

## THE LANGERMANN'S KOP OR SOUTH RIETFONTEIN SERIES AND THE MARKET SQUARE—FAIRVIEW SERIES.

### *At Rietfontein and Beyond.*

Eastwards at Rietfontein the large pebble beds of the Langermannskop Series are to be seen in the same geological position as at Langermannskop. It must be noted that both through the town of Johannesburg and through Troyeville, and at the outcrops in the Bezuidenhout Valley and at Rietfontein, the strike of these beds is parallel with the strike of the overlying or next successive beds, namely, the Market Square-Fairview Series (Government Reef Series). Also there is no divergence of dip more than is to be found anywhere on the Rand between the various beds of the Witwatersrand system, due to irregularity of folding. These facts alone make it very difficult to understand how these beds, if they were Elsburg Series, could have arrived at their present position. It would mean that an unconformable series had been wedged in apparently conformably, between the beds of a much older series, and that along a line of many miles in length, which is almost impossible. At Rietfontein the section as above described is partially obscured through the occurrence of some really unconformable beds, probably belonging to the Ventersdorp system, and consisting of indurated Quartzites and ferruginous Shales which lie across the formation at the west end of the Rietfontein property, and under these the beds of the South Rietfontein Series proper are seen to be striking.\* This unconformable formation occurs in patches here and there over the Rietfontein property, and further east the Rietfontein beds are completely obscured by a covering of coal measures of the Karroo system.

On the farm Witkopjes No. 157, however, immediately north of Driefontein No. 148, the lower Witwatersrand beds are outcropping, and a complete section from the Orange Grove Quartzites to the Hospital Hill Quartzites is to be seen, including the Yeoville Shales and the typical Hospital Hill Shales and Quartzites in their normal position. On following the Hospital Hill Quartzites eastwards from this

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\*On the northern side of Langermann's Kop there is a considerable area covered by similar rocks. These are dipping and striking unconformably to the strike and dip of the beds of the true Langermann's Kop or South Rietfontein Series which makes up the main mass of the kop.



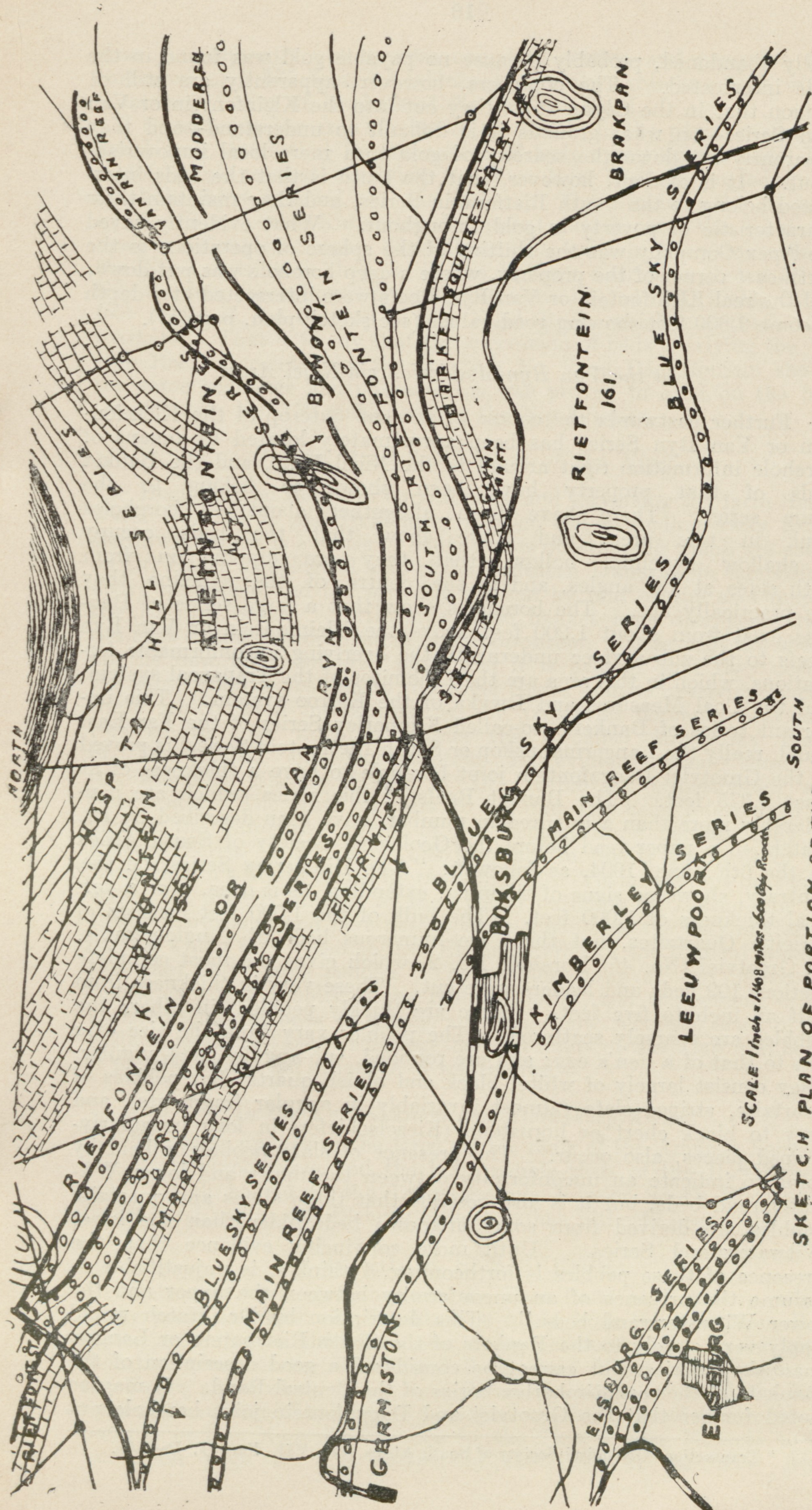
point it is found that they strike south-east in the direction of Benoni, and on arriving at the vicinity of the Kleinfontein Mine, one finds them dipping to the south-east and striking to the north-east with about 2,000 feet of Shales and Quartzites intervening between them and the Van Ryn or Kleinfontein Series of Reefs, these being evidently the first important pebble bed series lying above the Hospital Hill Quartzites. On the dip of the Kleinfontein or Van Ryn Series a number of pebble beds, having all the characteristics of the South Rietfontein or Langermannskop beds, are to be found. In passing, it may be remarked that the foot wall shale of the Kleinfontein or Van Ryn Reefs is a very peculiar rock, and is identical in appearance and character with the foot wall shale of the Rietfontein Series. The gold-bearing Bankets of Kleinfontein are also identical in appearance and character with the Bankets of the Du Preez and Rietfontein Series worked at the Rietfontein Mine, and, in many respects, they are dissimilar to the Main Reef Bankets. One notable feature is the sericitic nature of the cement, and also the fact that the predominant form of the pyrites present is that of marcasite.

The Quartzites of No. 6 Market Square-Fairview Series and its banded and contorted Shales are outcropping boldly to the south of the South Rietfontein Series. At Rietfontein they occupy the same position, namely, between the South Rietfontein Series and the Main Reef Series, and are striking to the south-east in the same manner as the South-Rietfontein Series. The outcrops of these beds can be followed right from Johannesburg, so that there is no question that they are the beds of No. 6, and that being so we should find immediately to the north of them the beds of the Yeoville Series, in case they are identical with the Hospital Hill Series No. 4, as the duplication theory makes out. Instead we find the same series of big pebble beds as at Langermannskop. How could the Elsburg Series always drop into the same horizon in this wonderful way? Surely the old theory is untenable!

#### *In the Kleinfontein-Apex Area.*

Eastwards of the railway line at Rietfontein, this important set of beds, the Market Square-Fairview Series, is obscured by the beds of the Karroo system above referred to. But on the south-eastern portion of the farm Klipfontein No. 242 they again crop out in the same relative position to the Main Reef Series, and are found to be striking to the south-east directly into the property of the Apex Mines. On some geological maps the course of this important series is described as cutting across Klipfontein No. 242 and Kleinfontein to a position north of the Kleinfontein Reef. There is not one shred of visible evidence to support this imaginary strike to the north-east; on the contrary, when last to be seen before again becoming obscured by the beds of the Karroo system, the beds are striking to the south-east as above noted, and furthermore an examination of the material brought up through the Glynn shaft on the Apex property (Rietfontein 324), shows that this shaft penetrated through these beds and into the highly characteristic striped and contorted beds of Shale (Market Square-Fairview Shale), which bears remarkable similarity to the Hospital Hill Shales, whose geological and actual position is about two miles to the north. The shaft gives evidence also that several of the large pebble beds of the South Rietfontein Series have been intersected. These facts show that both the Market Square-Fairview Series and the South Rietfontein Series continue under the coal measures into the Apex property, and they constitute a barrier against any permanent strike of the Kleinfontein Reefs towards the south-west, as at present is shown on geological maps of the area. The Glynn shaft was even-







tually abandoned, probably because no payable gold was found in the beds intersected. The engineers, however, apparently are still of opinion that in the Glynn shaft they cut into the Kleinfontein or Van Ryn Series—on what grounds it is difficult to understand—and they apparently set down the scarcity of gold to a mere local impoverishment. It is evident, however, that the truth is that the beds intersected belong to the South Rietfontein Series, and they maintain their characteristic of poverty in gold throughout. What evidently saved the Apex Company was the shifting of the sphere of operations to the north-east corner of the property, where a deep borehole was put down, and the real Kleinfontein or Van Ryn Reefs were intersected at a depth of some 2,800 feet showing good values (see sketch plan, page 17).

*In the Van Ryn-Modderfontein-Nigel Area.*

Further eastwards the course of the sub outcrop of the Kleinfontein or Van Ryn Series has been approximately located by means of borehole information right around to the Nigel Mine, and the Banket beds of that property have been shown to belong to the same series. There have been altogether about 40 boreholes sunk in this area, and these show that the beds occupy a shallow synclinal hollow, that they are dipping in from both sides at low angles, and in the centre of the syncline they are practically flat. The boreholes show that a large series of Bankets exist from about 1,200 feet above the Kleinfontein or Van Ryn Reefs to the sub surface underneath the overlying unconformable formations, which in this area are the Dolomites of the Transvaal system, and the Coal Measures and Dwyka of the Karroo system. This important series of Bankets (so-called Kimberley Series of the Far East Rand, really the Langermannskop or South Rietfontein Series) is proved in the Grootvlei Daggafontein joint borehole to have a thickness of at least 2,375 feet. The Banket Reefs of this series, which are considerably more than a hundred in number, have been described by Dr. Hatch, in a paper read before the Geological Society of South Africa on the 6th June, 1904, as follows\*: “The Kimberley Series, on the contrary, shows no signs of thinning, extending, as it does, over a vertical thickness of 1,000 feet. The bulk of the 1,000 feet consists of sericitic Quartzites, but there are numerous beds of Conglomerates. In Grootvlei (No. 45) Borehole No. 2, which gives the most complete section, 109 beds and leaders were cut. These vary in thickness from half an inch to five feet. Some are thickly pebbled, in others the pebbles are sparsely scattered. The pebbles vary from the size of a pea to that of a hen’s egg; and are rounded, sub-angular, and angular. They consist largely of white, black and bluish quartz; but pebbles of quartzite, striped slate (almost invariably in angular fragments), and grey to black chert or hornstone (Kieselschiefer) in long irregularly-shaped pieces, also occur. The presence of slate pebbles is held by some to indicate an unconformity between the upper and lower Witwatersrand beds, but it is also possible that these slates and quartzite pebbles are derived from some unknown beds older than the lower Witwatersrand Series. Until more convincing evidence than the presence of these pebbles is forthcoming, I think it is unjustifiable to assume the presence of an unconformity between the upper and the lower Witwatersrand beds.” This description by Dr. Hatch would apply very closely to the Bankets of the South Rietfontein or Langermannskop Series, but cannot be considered a good description of the Bankets of the real Kimberley Series of the Central Rand. It may be noted further that the Grootvlei and Daggafontein joint borehole put

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\* Transactions Geological Society of South Africa, Vol. VII., Part II., Page 65.



down subsequently cut a more complete section and proved a total thickness of 2,375 feet. A thickness greatly exceeding that of the Kimberley Series of Bankets of the Central Rand.

Considering the area further to the south, in the paper cited above Dr. Hatch states that the succession of beds overlying the Nigel Reef is the same as that overlying the Van Ryn Reef as proved in the borehole above referred to. He states: "These include the Amygdaloidal Diabase, the Kimberley Basement Slates, and the Kimberley Series of Conglomerates. That these beds exist in the same order in the Nigel district as they do in the Springs district is shown by the Grootfontein borehole put down by the Consolidated Gold Fields, 12,000 feet north of the outcrop of the Nigel Reef, which cut these three markers." That is to say that the succession of beds overlying the Van Ryn Reef intersected by the borehole No. 2 on Daggafontein showed the same sequence and character as was proved to exist on the farm Grootfontein No. 152 and overlying the Nigel Series.

#### *In the Area South-West of the Nigel.*

Beginning on the farm Grootfontein and traversing the farm Spaarwater No. 154 in the Heidelberg district and extending away to the south-west there is a series of banket reefs outcropping which are shown on Dr. Hatch's geological map of the Southern Transvaal in the position above described, and the series is marked by him on the said map as the Elsburg Series. Northwards these banket beds disappear under the beds of the Karroo System on Grootfontein. These beds are shown on the new map, coloured pink, and it is evident that they occupy the same relative position to the Nigel Series and its overlying beds as those which were intersected by the Grootvlei borehole previously referred to. Or in other words the so-called Kimberley Series of Dr. Hatch on Daggafontein is evidently the same as the so-called Elsburg Series of Dr. Hatch on Grootfontein and Spaarwater. The truth appears to be that the beds referred to are neither the Kimberley Series of the Central Rand nor are they the Elsburg Series of that area, but they are in reality the beds of the Langermann's Kop or South Rietfontein Series. Their outcrops on Spaarwater are exactly similar to the typical outcrops on Rietfontein and Langermannskop, and here note may be made that the only characteristic in which they resemble the Elsburg Series of the Central Rand is that they carry large pebbles. The pebbles, however, are different in character to the pebbles of the Elsburg Series, and the cement in the Langermannskop beds is strong and tenacious, whereas most of the Elsburg reefs are loosely held together and many of them fall into heaps of pebbles under the influence of weathering.

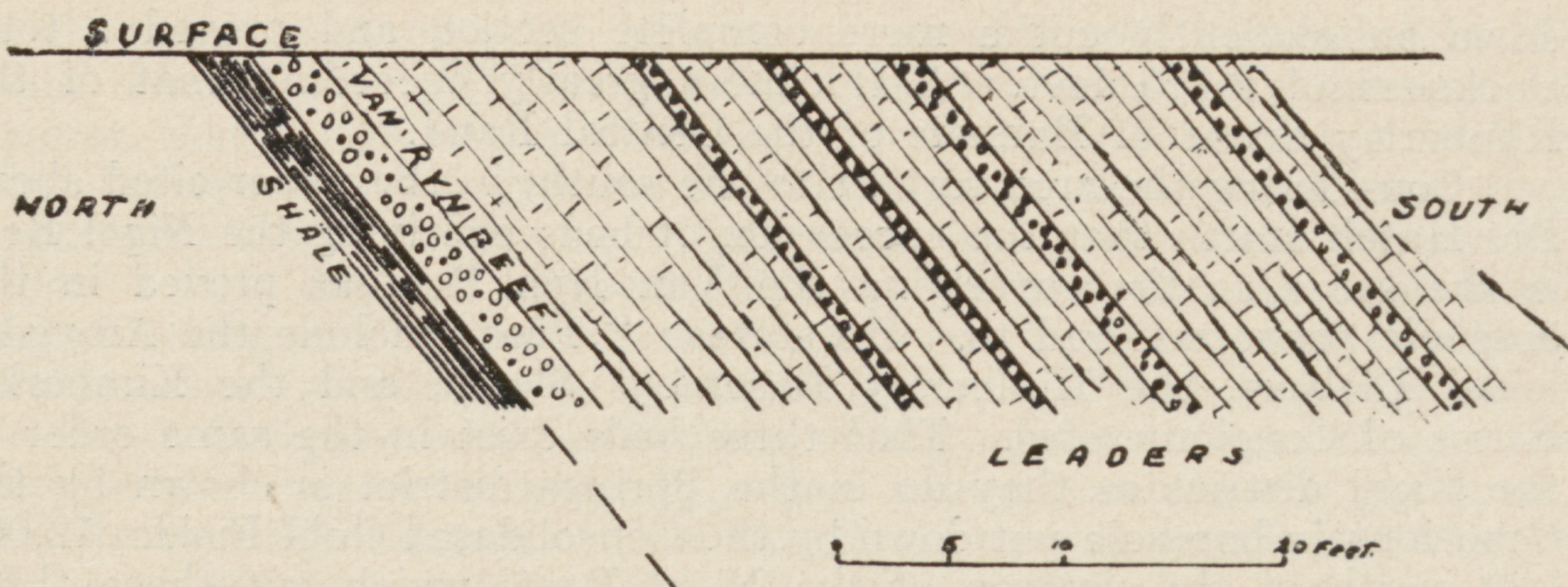
#### *In the Venterskroon and Klerksdorp Areas.*

The same applies to the large pebble reefs of the Amazon Series of the Venterskroon area and the large pebble reefs of the Buffelsdoorn area. Both belong to the Langermann's Kop or South Rietfontein Series, and not to the Elsburg Series, as has hitherto been held.

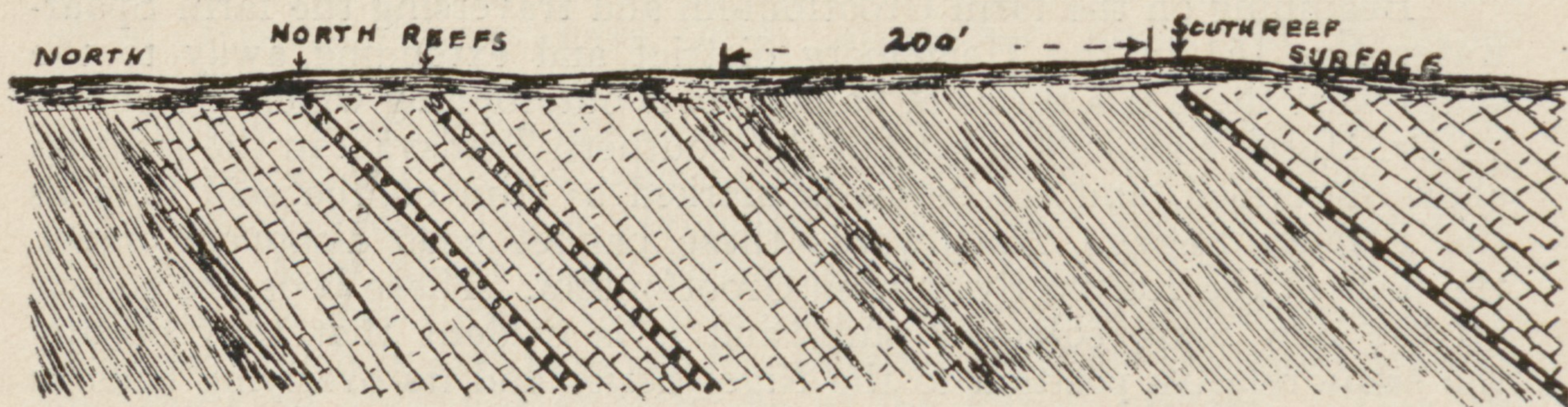
### THE BLUE SKY SERIES.

Retracing one's steps back to the East Rand at Boksburg, which is the point at which the departure is made from the real Main Reef Series according to the views now being set forth, it is to be noted that the mines of the East Rand Proprietary Mines, Ltd., as far as the Cason are working Main Reef Series the same as the Main Reef Series throughout the Rand. A section of the beds of the southern outcrop of the Main Reef Series in the New Comet Mine is to be found on page 20. A section of the beds in the New Blue

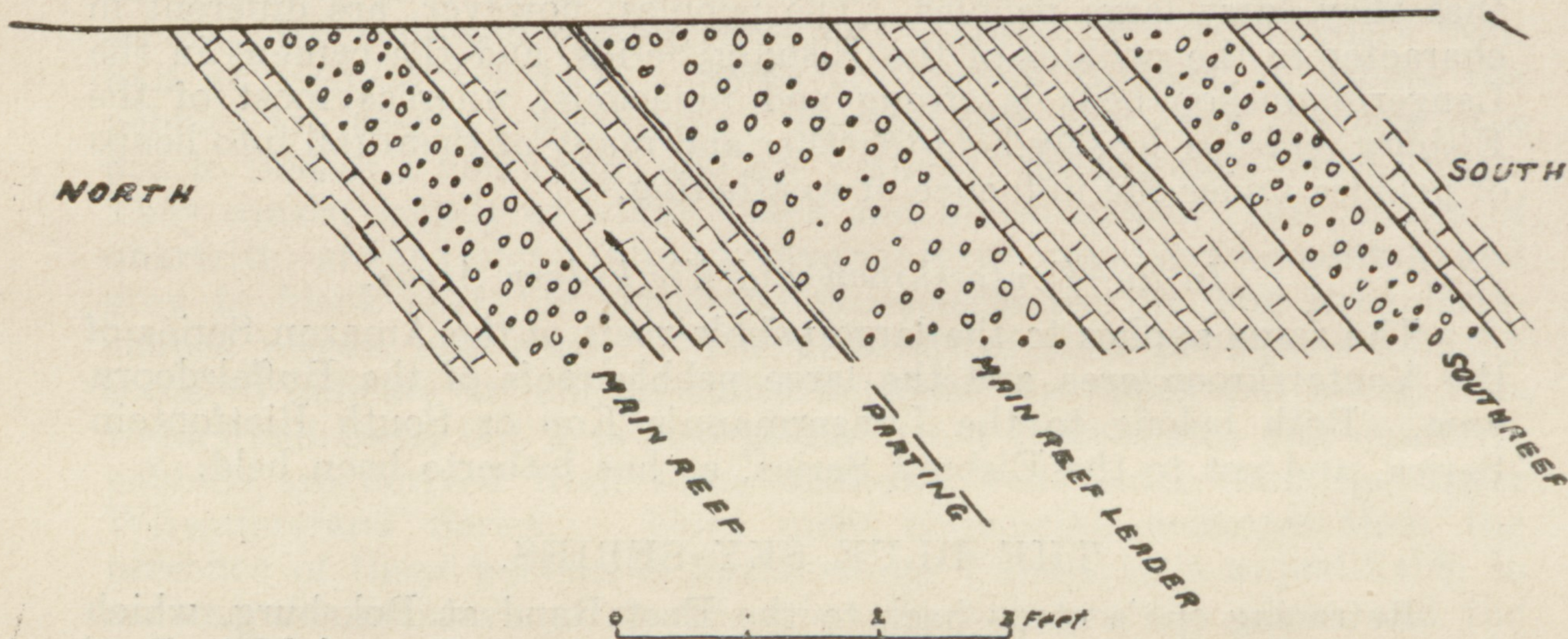




TYPICAL SECTION OF THE VAN RYN SERIES



SECTION ACROSS NEW BLUE SKY SERIES



Section of the South occurrence of the Main Reef Series at  
the New Comet Mine.



Sky Mine is also to be found on page 20. These sections are seen to be quite different one from the other. In the Blue Sky there is an intervening bed of shale 200 feet thick between the reefs. Such a section is not to be seen on any of the Main Reef Mines of the Rand, and it requires a very strong faith to accept the beds it represents as belonging to the Main Reef Series, more especially as the blanket of which the beds are composed is also dissimilar both in its character and its gold bearing qualities to that of the Main Reef Series. It should be added that the shale, 200ft. thick interbedded between the Blue Sky reefs, is different in character to the small schistose layer usually a few inches thick, and never more than a few feet, which underlies the Main Reef Leader in all Main Reef mines to the west of the Cason. It is a very striking and significant fact that beyond the Cason Mine there are no working batteries nor any tailing dumps on the line of the Blue Sky Series, and that although the companies holding the ground were formed in some cases fifteen years ago. The evident reason is that the values met with in development have not encouraged the management in any case to proceed with milling operations. When it is known that similar beds to those of the Blue Sky are to be found outcropping north of the Witwatersrand Gold Mining Company's property, and that beds in a similar section are to be seen north of the Main Reef at other places along the Rand, it becomes very probable that the Blue Sky reefs belong to those more northern beds, and do not belong to the Main Reef Series proper, and it is further to be observed that this Blue Sky Series is now being developed by the Boksburg Gold Mines, Ltd., the East Rand Extension G.M. Co., Ltd., the Van Dyk Proprietary Mines, Ltd., and the Rand Collieries, Ltd., and with the exception of an area in the East Rand Extension Mine and some limited areas in the other mines, the development of these beds in these mines shows erratic or unsatisfactory values over large areas. This uncertain gold value is evidently a characteristic of the Blue Sky Series.

It is also to be noted that the section shown in the Blue Sky and the other mines enumerated, is different from the sections of the Kleinfontein or Van Ryn Series or of the Nigel Series. In other words, the section of Blue Sky Series is neither that of the Main Reef Series nor of the Van Ryn Series, and the conclusion is that it belongs to the upper beds of the Market Square-Fairview Series (Government Series). That is, older than the Main Reef Series.

### THE REAL EXTENSION OF THE MAIN REEF SERIES.

Further it is concluded that the sub-outcrop of the Main Reef Series lies more to the south or further in towards the interior of the syncline. It is almost certain that this most valuable series was opened by Mr. J. L. Gauf fifteen years ago on Leeuwpoot No. 284. The reefs he opened gave high gold values, and he always stated that they belonged to the Main Reef, but owing to their position they were generally held to belong to the Kimberley Series.

Towards the South-East the course of the Main Reef Series is obscured by surface coverings of Dwyka and beds of the Karroo System, but fortunately it outcrops again on the property of the Van Dyk Proprietary Mines to the south of the present workings of that company. On the same property there is to be seen a typical outcrop of the Bird Reef Series overlain by the very characteristic shale bed known as the Bird Reef marker in the Central Rand. And on the claims formerly held by Mr. J. W. Link on Leeuwpoot, there is a typical outcrop of the real Kimberley Series of the Central Rand striking north-west south-east.



This description is of course contrary to all accepted theories, and indicates the position of the Main Reef outcrop in places far to the south of any previous location in this district; in fact, the beds on the Van Dyk property, identified in this treatise as the Main Reef Series and the Bird Reef Series, have been marked hitherto as the Elsburg Series, although they are quite unlike that series. That the new reading is correct and the old one is wrong might well be claimed from the stratigraphical and petrological data already described. But there is a further consideration of a tectonic nature by which it is still more completely established. Before, however, proceeding to explain this consideration, it will be as well to recapitulate briefly the conclusions arrived at so far.

### THE NEW CONCLUSIONS.

1. That the supposed diagonal fault through the Bezuidenhout Valley, causing a duplication of the Hospital Hill Series, does not exist in fact.

2. That the large series of Bankets and Quartzites on Kensington Estate is not a detached and unconformable portion of the Elsburg Series, but is an outcrop area of a distinct and conformable series of the Witwatersrand system (the Langermannskop or South Rietfontein Series) underlying the Market Square-Fairview Series (Government Reef Series of the West Rand).

3. That the Langermannskop or South Rietfontein Series exists throughout the Rand, that it outcrops on Middlevlei on the West and again on Waterval and Alexandra Estate north of Krugersdorp, again north of Roodepoort and with smaller pebbles on to Johannesburg where it outcrops on the Von Brandis Square, that it is known at Johannesburg as the Langermannskop Series, at Rietfontein as the South Rietfontein Series, and on the Far East Rand it is mistakenly called the Kimberley Series, and on Grootfontein and Spaarwater and on towards the south-west it is wrongly identified as the Elsburg Series, and in the Venterskroom area it is known as the Amazon Series, and there too it is wrongly classed by most geologists as Elsburg Series.

4. That the hard Quartzites and striped Shales outcropping on the Market Square and President to Pritchard Streets, Johannesburg, and striking through Jeppes Station, Fairview, Kensington to Rietfontein eastwards, and on to Roodepoort westwards, and beyond Witpoortje round the Krugersdorp-Randfontein area, are not duplications of the Hospital Hill Shales and Quartzites, but belong to a permanent and distinct series called here the Market Square-Fairview Series, which outcrops throughout the Rand, whose position is between the South Rietfontein or Langermannskop Series above described and the Main Reef Series, and it is the same series which in the West Rand is known as the Government Reef Series.

5. That the Kleinfontein or Van Ryn-Nigel Reefs do not belong to the Main Reef Series, but they belong to the Rietfontein or Du Preez Series. That they do not continue with a south-west strike into the Apex property, as they would in that case intersect the beds of the South Rietfontein Series and the beds of the Market Square-Fairview Series, but that at some point on Benoni their outcrops, which are obscured by coal measures, turn to the north west, and they follow conformably on the dip of the Hospital Hill Quartzites, which outcrop all the way to Witkoppies.

7. That the Blue Sky Reefs belong neither to the Main Reef Series nor the Rietfontein or Van Ryn Series, but to an intermediate series whose position is south of the Market Square-Fairview Quartzites and north of the Main Reef Series.



8. That the extension of the Main Reef Series of the Central Rand eastwards is to be found throughout Leeuwpoort, Witpoort, Vlakfontein, and so on southwards well in towards the interior of the main synclinal fold of the Witwatersrand system existing in the Southern Transvaal.

### CHAPTER III.

#### A NEW VIEW OF THE TECTONICS OF THE WITWATERSRAND SYSTEM AND ITS BEARING ON THE EXTENSIONS OF THE MAIN REEF SERIES OF THE CENTRAL RAND.

##### *THE OLD GRANITE THE FLOOR OF THE WITWATERSRAND SYSTEM.*

On the geological map accompanying this treatise there will be seen five areas of the old granite belonging to the Archaean system of South Africa. In none of these areas is there any known occurrence of an intrusion of this granite into the Witwatersrand beds. At one or two places in the Venterskroon area there are small granite areas surrounded by the Witwatersrand beds, but in these cases the granite appears to be of a different character to the old granite above referred to, and it probably belongs to a much later period. However, in every area the contact of the Witwatersrand beds with the granite, is followed by the same succession of Witwatersrand beds, namely: the Basal Conglomerates and Quartzites of the Orange Grove Series, then the Yeoville Shales, Hospital Shales and Quartzites, etc. This is the case in all the areas referred to. At one point on the farm Varkenskraal No. 354 where the unconformable Black Reef Series is eroded, one of the basal conglomerates is to be seen resting on the granite in such a manner as to leave no doubt that the granite was the floor on which the pebble bed was deposited. Similar conditions are visible at Rhenoster, west of Rietkuil, in the Klerksdorp District. The conclusion arrived at therefore is that the granite is intrusive only in the Archaean System, and that it is not intrusive in the more recent Witwatersrand system, but belonging as it does to the Archaean System, it, together with the schists of that system, formed the original floor on which the sedimentary rocks of the Witwatersrand System were laid down.

##### *The Folding of the Witwatersrand System and its Archaean Floor.*

As stated above, the order of succession of these beds from the granite inwards towards the interior of any synclinal area is invariably the same, that is to say, the section is Granite, Orange Grove Series, Yeoville Series, Hospital Hill Series, and so on, whether the section is taken from Orange Grove southwards at Johannesburg or from the granite at Parys northwards or from any point on the Granite in any of the five areas referred to. It is evident therefore that the foldings of the Witwatersrand beds into their present positions were brought about by earth movements which caused anticlinal and synclinal foldings, not only of the Witwatersrand beds, but also of the Archaean floor on which they were laid down. It will be seen later that these foldings took place before the outpouring of the lava flows of the Vaal River System.

##### *Conditions in a Deep Synclinal Area.*

Along the Central Rand the dip of the Witwatersrand beds is steep, that is to say, the average is 30 degrees or over and the dip continues steep even in depth. This is proved by the deep level mines and bore-



holes of the Rand. In the Venterskroon area the Witwatersrand beds are dipping steeply towards the south, that is, towards the granite, but inasmuch as the order of succession of the beds from the granite northwards is the same as the order of the succession of the beds from the granite southwards at Johannesburg, it is evident that this dip to the south is caused by over-tilting, that is to say, the beds have been folded so much that they have passed the vertical and have been turned slightly over until the lower beds appear to be overlying the later or more recent beds of the series. The phenomena can be quite clearly explained on the theory indicated by the steep dip of the beds, that the synclinal fold in the area between Johannesburg and Parys was a very deep one, that is to say, the synclinal hollow formed, caused the beds to be sunk into a curving synclinal fold of great depth.

At Johannesburg the estimated total actual thickness of the Witwatersrand beds from the granite to the beds of the Elsburg Series, is approximately 25,000 feet. The Main Reef Series occupies a position about midway up in the series, that is to say, about 12,000 feet above the granite, geologically speaking. As has been stated, the beds along the Central Rand are dipping steeply to the south and the present plane of the earth's surface in that area shows a section of the series and exhibits the beds lying up against the granite and one another in successive order, and it is possible under these conditions of steep dip to traverse the whole series in the course of a seven-mile walk from Orange Grove to the uppermost beds of the Elsburg Series. In a section across the syncline from the granite at Orange Grove to the granite at Parys, there is an intervening distance of about 60 miles, and on the Parys side of the synclinal hollow indicated by the above facts, it must be remembered the folding has caused the beds not only to be steep but to be actually overtilted.

All the facts indicate that between the two points mentioned (Orange Grove and the north of Parys) there is an ultra deep and wide synclinal fold, not only of the Witwatersrand System, but also of its Archaean floor. (See section along line A—B.)

#### *Conditions in a Shallow Synclinal Area.*

While these conditions of steep dip prevail along the Central Rand, the conditions on the Far East Rand are totally dissimilar. From the granite proved on the farm Vlakfontein north of the Van Ryn to the granite on the farm Uitkyk, east of the Nigel, the distance is only about 30 miles. The intervening country has been intersected by numerous boreholes, about 40 in all. In most of these the well marked series of the Van Ryn or Rietfontein bankets has been proved. The position of the strata as disclosed by these operations shows that the beds remaining of the Witwatersrand System occupy in this area a flat saucer-shaped synclinal hollow, and seeing that on both sides of this shallow area the Orange Grove rocks are in evidence resting on the granite, it is evident that if the full known sequence of the Witwatersrand beds, approximately 25,000 feet thick, were to-day placed in position across this area, it would necessitate the existence of a hollow topped table mountain, probably 15,000 feet high, and capped by the Elsburg Series, because as soon as it is ascertained that the lowest beds of the series are resting on the granitic floor in a comparatively flat position the succeeding and upper beds, if present, must be resting on top of the earlier or lower series, and so on in succession. As it is a fact that there is no such hollow topped table mountain in the area in question, it becomes evident that the full sequence of the Witwatersrand beds does not exist in that area to-day, and the further conclusion is forced on one's mind that the upper beds



of the Witwatersrand system have been removed by erosion. That whereas on the Rand, with its steep dip, it is possible to cover the whole system up to the Elsburg Series in the course of a seven-mile walk from Orange Grove to Elsburg, under the conditions shown to exist on the Far East Rand, starting at the granite at any point and walking inwards from the eastern margin, of the main deep synclinal fold which is indicated as existing between Johannesburg and Parys, a distance of 10, 15, or 20 miles may have to be traversed before the horizon of even the Main Reef Series would be reached, or to vary the explanation the facts indicate a main synclinal fold, whose longitudinal axis extends approximately from Springs through Potchefstroom towards the south-west, and whose main transverse axis is, say, from Orange Grove at Johannesburg, to the granite north of Parys in the Free State, and this synclinal fold is concave not only transversely but also longitudinally. The Archaean floor being probably deepest about the centre of the area, and curving up towards the south at Parys, and towards the north at the Rand, and shelving up longitudinally towards the north-east at Springs and beyond, until the granite itself may come to the sub-surface under the coal measures in the far north-east of the Far East Rand, the beds of the Witwatersrand System at their outcrops or sub-outcrops, being wider apart or closer together in ratio as the dip of the beds is steep or flat around the margin of the whole deep synclinal area. The Rand, Heidelberg, Venterskroon, and Klerksdorp areas, representing anticlines whose acclivity is more or less in ratio to the declivity of the synclines on their dip.

This line of reasoning leads to the conclusion that it a physical impossibility for the Main Reef Series, which is comparatively high (about 12,000 feet in the system), to exist to-day so near the granite in a shallow synclinal area such as that known as the Far East Rand, lying between Vlakfontein (Van Ryn) and the Nigel, but that owing to the known condition of low angle of dip its present sub-outcrop must, as stated above, be far in towards the interior of the main synclinal area.

*The Amygdaloidal Diabase and other Formations unconformably covering the Witwatersrand Beds.*

The next consideration is the position of the Amygdaloidal Diabase in relation to the underlying Witwatersrand System. A reference to the main map will show that the Amygdaloidal Diabase is found in many places at the present surface in almost every area where the Witwatersrand beds have been exposed.

*The Diabase Preceded by a Prolonged Period of Intense Erosion.*

Its situation on the north-eastern portion of the Rand, following the Bezuidenhout Valley, and covering part of the lower beds of the Witwatersrand System, and extending over on to the granite area at Zuurfontein No. 369, shows that this great lava flow or series of lava flows, occurred not only after the Witwatersrand beds had been folded into anticlinal and synclinal folds, but that it or they took place after a period of intense erosion sufficiently prolonged to have caused the planing down of the anticlinal areas over which the Witwatersrand beds were curved, and the exposure of the original granite floor in several areas, but also that the erosion which took place during that prolonged and far-off period not only planed off the anticlines, but it planed down the shallower synclinal areas as well. Some of the shallower synclinal folds no doubt disappeared altogether, those less shallow, such as that on the Far East Rand, were only partially removed, and the Far East Rand area may be considered to-day as the basal portion of such a



shallow synclinal fold containing only the beds up to and including the South Rietfontein Series. The beds above having been removed by erosion in that area right to their present sub-outcrop farther in towards the interior of the main syncline.

*The Main Reef Series can only exist to-day in the Interior of a Deep Synclinal Area.*

It becomes clear on this line of reasoning that it was only where by good fortune an ultra deep synclinal fold existed that the full sequence of the Witwatersrand System escaped destruction, and it is evidently owing to this that the important and valuable Main Reef Series remained under the conditions of position of the Central Rand preserved in this way to become the basis of the gold industry of the Transvaal. One could almost say that if it had not happened that the main synclinal fold, with its longitudinal axis extending from Springs to Potchefstroom had not been of such a deep character, resulting in the setting of the beds of the Witwatersrand System deep into the crust of the earth, there would have been no Main Reef gold industry to-day, as without it the upper beds of the Witwatersrand Series, in which the Main Reef Series must be included, would have been destroyed in that far off period of erosion which occurred before the deposition of Amygdaloidal Diabase of the Vaal River System. The old surface of the area, before the outpouring of this enormous flow of lava, was that which would be left at the end of a period during which the Southern Transvaal had existed for long as a land surface, the surface rocks being the exposed areas of the Archaean System (granite and schists) and the sections of the Witwatersrand System that had been exposed by erosion.

*After the Prolonged Period of Erosion.*

The deposition of the Amygdaloidal Diabase and of the other beds of the Ventersdorp System, which consist of shales, quartzites, boulder beds, and conglomerates, as well as igneous rocks, was succeeded by the deposition unconformably of the Black Reef Series, the Dolomite Series, and the Pretoria Series, together making up the Transvaal System. These beds must have been deposited during a period when the area in question had again become submerged. Succeeding these again unconformably came the Dwyka Conglomerates and the coal measures of the Karroo System. Later the whole area was again elevated into a land surface, probably with minor foldings of the earth's crust, which, however, were not to be compared in importance with the previously described pre-Vaal River System folding of the Witwatersrand System and its Archaean base. The last-mentioned period is that in which we are now living, and the processes of erosion which set in whenever an area becomes a land surface, began and are still going on, and have reached the stage where in the area dealt with in this treatise the coal measures and Dwyka of the Karroo System cover parts only of the Far East Rand, Heidelberg, and Vereeniging districts, the Pretoria beds remain covering about one-third of the area, the Dolomite and the Black Reef appear all around the areas occupied by the Pretoria beds. The Dolomite and the Black Reef Series have in many places been eroded sufficiently to show long narrow exposures of the Amygdaloidal Diabase of the Ventersdorp System, and these lava sheets in turn have been and are being worn away, exposing in turn the beds of the Witwatersrand System and the old granite, and the process of erosion of the old exposed uptilted edges of the Witwatersrand beds is again going on after many ages, during which they were covered by the later unconformable beds above described.



*The Erosion of the Diabase Most Complete on the Rand.*

The fact of greatest economic importance is that it has so happened that on the Rand the stage of erosion arrived at so far as the Amygdaloidal Diabase is concerned has been sufficiently far advanced to clear the Diabase off, for the most part not only from the lower but also from the upper beds of the Witwatersrand System, viz., the Main Reef Series, and the Bird, Kimberley and the Elsburg Series. The probable reason of this fortunate occurrence being that the Witwatersrand stands higher than any other area in which the Rand beds are exposed.

*In Other Districts Erosion not so Far Advanced.*

But for a few exceptions it might be said that this, however, has occurred on the Rand, and on the Rand only. Beyond Boksburg, and in all the districts around Heidelberg, Venterskroon, Potchefstroom, and Klerksdorp, the erosive processes affecting the diabase and other unconformable series has not advanced sufficiently to expose the horizon in which the Main Reef Series occurs in the Witwatersrand system. For the most part in these areas the sequence and the exposed succession of Witwatersrand beds comprises only from the granite to the South Rietfontein Series, and in places to the Market Square-Fairview Series. There are indeed localities where both of these series and all the lower beds and the granite itself remain covered by the diabase.

*Exposures of the Main Reef Horizon Outside the Rand.*

Beds higher than these in the Witwatersrand Series are to be seen uncovered at only a few places outside the Rand. For instance, on the farm Witpoort No. 297 (Van Dyk Proprietary Mines), where there are exposures of the beds of the Main Reef Series and the Bird Reef Series; the farm Knoppiesfontein No. 98 in the Free State, immediately south of the Vaal River, in the Heilbron District, where there are also exposures of the Main Reef and Bird Reef horizons; the farms Leeuwfontein No. 630 and Tygerfontein No. 641 and Nooitgedacht in the Venterskroon area, where there are exposures of the horizon of the Main Reef Series, and again the farms Rheeboeklaagte and Rheeboekfontein 131 in the Kroonstad District of the Free State, where there are also exposures of the Main Reef horizon. In each case, except that on Witpoort, these exposures are surrounded by the Diabase of the Vaal River system, lying unconformably across the outcrops as shown on the map. At other places the Diabase still covers practically the whole of the Witwatersrand system. Such places are to be found in the Heidelberg District in the area north of the farm Knoppiesfontein No. 98 on the Vaal River. In the area between Randfontein and Klerksdorp, the upper Witwatersrand beds are still covered, not only by the Diabase of the Vaal River system but also by the Black Reef and Dolomites of the Transvaal system. It is in these first-named areas that search is about to be made by means of surface trenches and boreholes, with the view of proving the existence and possible payability of the Main Reef Series. There are indications that the beds are there, more or less, as they have been proved to be along the whole 50 miles of exposed outcrops on the Rand, and when found it can be said that there is some evidence showing a fair probability that the gold values will also be obtained. The underlying Van Ryn or Rietfontein Series is actually exposed, and has been opened up at several places far apart in all the areas referred to. And in each case where this gold-bearing horizon occurs, the Banket Series is accompanied by the very characteristic foot wall shales of the series, and encouraging gold values are met



with. Especially is this so in the Venterskroon area. This is one of the facts which encourage the hope of similar values to those of the Rand being found when the Main Reef Series itself is exposed.

### *Small Outlying Synclinal Areas.*

On the south east portion of the area shown in the accompanying map there is to be seen what is known as the south-east Heidelberg syncline, and in the western portion there is to be seen an area known as the Rietkuil area, north-west of Klerksdorp. These areas represent the basal portions of more or less shallow or narrow synclines from which the upper beds, including the Main Reef Series, have been eroded, leaving only the Rietfontein Series as the economically valuable series of the gold mining industry, which has been established in the Rietkuil area, and may be established sooner or later in the south-east Heidelberg area. With proper prospecting it is possible that the Van Ryn or Rietfontein Series may be located right around all these basal synclinal areas.

### *The Witpoortje and Stubbs Randfontein Faults Explained.*

It will be convenient here to give an explanation, on the new ideas of the famous Witpoortje Fault and the analogous fault which traverses the properties of the Stubbs Randfontein and the South Randfontein Deep. It is no doubt generally known that the latter fault (Stubbs Randfontein) has been a barrier for more than twenty years to the location of the Main Reef Series to the south of Randfontein. It must first be observed that the Bothas and Randfontein Series are one and the same and that they are the extensions of the Main Reef Series of the Central Rand. The displacement at Witpoortje between the western end of the Main Reef Series in the Roodepoort area and the eastern end of the Bothas or Main Reef Series at Greys Mynpacht in the Krugersdorp area is about nine thousand feet. The displacement at Stubbs is about four thousand feet (see the main map). Both of these major faults and the many minor ones as well were caused simply through inequalities or irregularities in the foldings of the beds. It is evident that the axes of the anticlines in the Middlevlei-Randfontein-Krugersdorp-Roodepoort district have different directions. The result is that the beds have been brought into their present positions with irregularities of strike and dip. On the Roodepoort or eastern side of the Witpoortje fault zone the upper beds of the Witwatersrand System have much lower angles of dip than the angles of dip of the lower beds in the same section. On the Grey's Mynpacht or Krugersdorp side of the Witpoortje fault zone the angles of dip of the upper beds are more uniform with the angles of dip of the lower beds in the same section. Consequently the upper beds on the Roodepoort side of the fault zone are spread out and cover nearly two miles more of the surface than the outcrops of the same beds on the Grey's Mynpacht or Krugersdorp side of the fault zone. Thus while the outcrops of the lowest beds of the Witwatersrand System are practically continuous across the fault zone and continue round on the north of Krugersdorp the outcrops of the upper beds from the Hospital Hill Series upwards are always increasingly further south on the Roodepoort side of the fault zone than the respective outcrops of the same beds on the Krugersdorp side of the fault zone. The fact seems to be that every marked change of dip along the strike of the beds means faulting commensurate with the change and every marked change of dip between the successive beds means irregularities of the folding, rolls or steps in the folds, necessitating wider surfaces for the outcrops or sections exposed by erosion where the beds have lower angles of dip and narrower surfaces for the outcrops where the angles of dip are high. On this reasoning the



phenomena of the Roodepoort-Krugersdorp-Randfontein-Middelvlei district can be easily explained. Beyond the Stubbs fault to the south where the displacement of the upper beds is about four thousand feet to the east the location of the Main Reef horizon becomes merely a matter of measurement.

#### AREAS OF ECONOMIC IMPORTANCE BEYOND THE PRESENT RAND.

Beyond Randfontein, immediately on the south, the Market Square-Fairview Series is exposed on Luipaards Vlei South No. 682 and on Middlevlei No. 610; the South Rietfontein Series being covered by the Black Reef Series, except at one place on the south-west of Middlevlei. At a place on Luipaard's Vlei some of the beds of the Main Reef series are outcropping, but have not yet been properly opened. The beds exposed there for a short distance south of Randfontein give abundant data for the location of the extension of the Main Reef Series, and there is little doubt that very shortly it will be opened up along that distance, now that the identity of the outcropping beds is established. On Venterspost No. 257 and right on to Klerksdorp, the Witwatersrand system is covered for the most part, not only by the Diabase of the Vaal River system, but by the Dolomite and Pretoria beds of the Transvaal system, and consequently this is an area where the location of any recognisable beds near the Main Reef horizon is extremely difficult, and for the present it may be left out of the sphere of practical work, so far as the Main Reef Series is concerned. Towards Klerksdorp the beds of the Rietfontein horizon containing gold, have been worked with moderate results, which may be improved on later. The areas of economic importance remaining round the main deep synclinal fold described in this treatise are those west of the town of Heidelberg running down to Knoppiesfontein No. 98 on the Vaal River, and the area round the horseshoe stretching from Wonderheuvel in the Free State on the east round to Rheeboekfontein on the west. In both these areas there are definitely recognisable beds outcropping, which will serve as valuable markers for the location of boreholes calculated to strike the Main Reef Series at moderate depth. Except for the places described above as showing exposures of the Bird and Main Reef Series, and in a few places where the Market Square-Fairview Series is uncovered, the uppermost exposed beds in both these areas are for the most part those of the important series which in this treatise is called the South Rietfontein or Langermannskop Series. In the Heidelberg District these beds have hitherto been mistaken for the Elsburg Series of the Central Rand, and in the Venterskroon District, where they are known as the Amazon Series, most geologists have also mistakenly identified them as the Elsburg Series. It will be noted that on the lines of reasoning given in this treatise it is on the Rand, and on the Rand only, that the outcrops of the Elsburg Series and the Kimberley Series are to be seen at all, and in only a few places outside the Rand are the Bird and Main Reef Series exposed. Hitherto it seems to have been taken for granted that the incidence of erosion of the unconformable diabase above agrees with the position of the Elsburg Series below. Such a coincidence might occur at places over limited areas, but to suppose it to be the rule is obviously absurd.

*The Extent of Main Reef Country available for Mining may be Trebled.*

Now that the real character and identity of the uppermost exposed beds in each area are known, prospecting will take a new line. In the stretch of country extending from Boksburg (East Rand) to Koppiessfontein on the Free State side of the Vaal River there are about 60



linear miles of outcrops or sub-outcrops of the Witwatersrand beds and along this line it is highly probable that the Main Reef Series of the Central Rand will shortly be located. From Vredefort Road round the horseshoe anticlinal area of Vredefort to Rheebofontein near the Rhenoster River it is about 80 miles and along this line, too, there are Witwatersrand beds outcropping nearly all the way. These outcropping beds give very definite data as to the position in which to look for the Main Reef Series under the diabase. Excluding for the present the country between Venterspost and Klerksdorp on the west as being covered too deeply by unconformable formations, there are in the two lines of country first mentioned 140 miles along which the Main Reef Series of the Central Rand can be looked for with confidence that success will result from the search. The present linear mileage of Main Reef actually worked on the Rand is about 45 miles. These two first mentioned areas, therefore, when explored, may treble the extent of Main Reef country available for actual mining. The hope is permissible that the results will well repay those who are adventuring for the great reward which may be expected from the discovery of the Main Reef Series of the Central Rand in these completely new areas.