

Report No. 2



**MINISTRY OF ENVIRONMENT AND NATURAL RESOURCES**

**MINES AND GEOLOGICAL DEPARTMENT**

**GEOLOGICAL SURVEY**  
OF  
**LOLGORIEN AREA**

by

**R. MURRAY-HUGHES, A.I.M.M., F.G.S.,  
Geologist**

**First print 1933  
Reprint 2007**

# SKETCH PLAN OF THE LOLLGORIEN AREA

TO ACCOMPANY REPORT BY R. MURRAY HUGHES

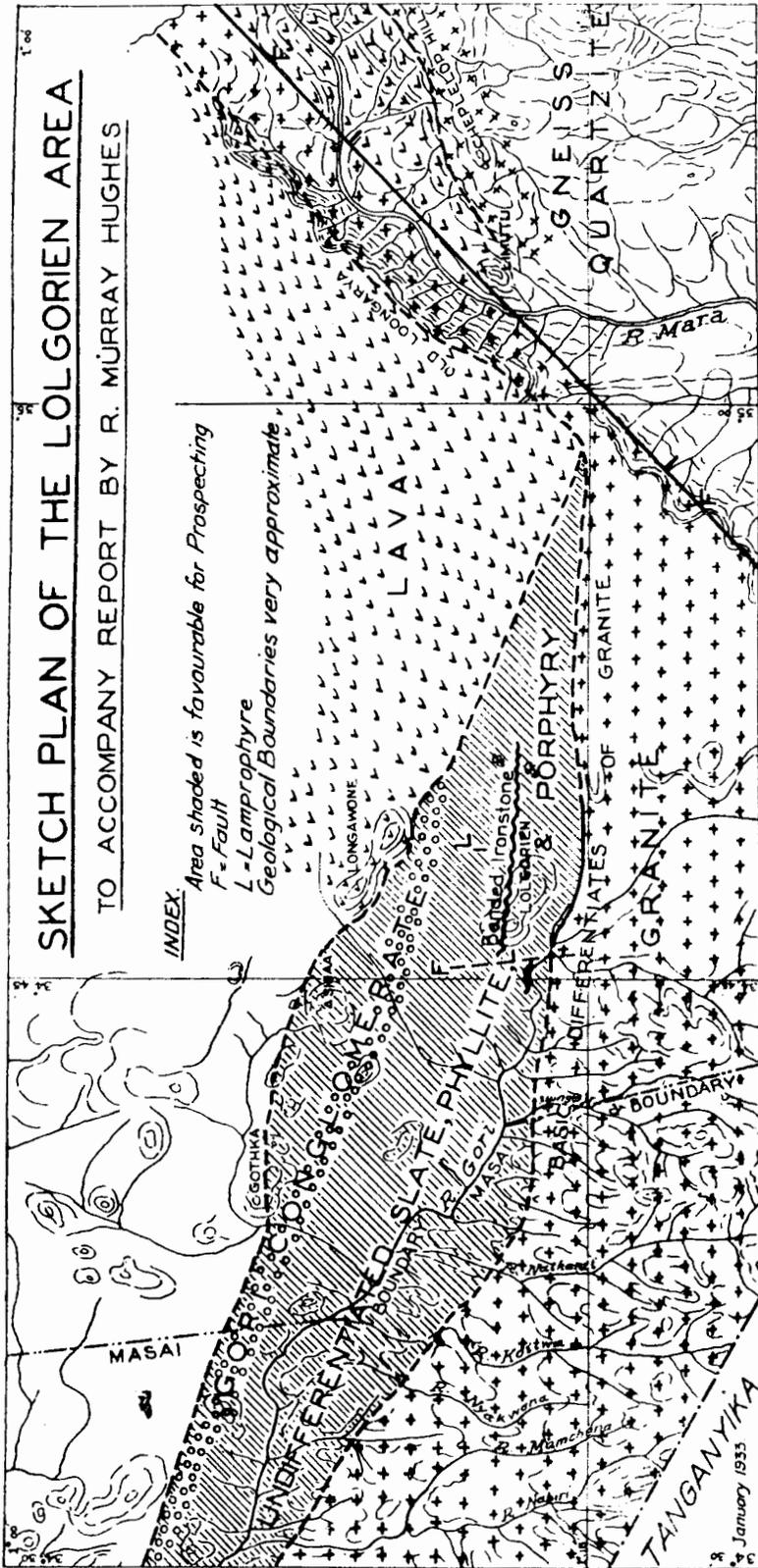
**INDEX.**

*Area shaded is favourable for Prospecting*

F - Fault

L - Lamprophyre

*Geological Boundaries very approximate*



# Introduction

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The following report is based on a reconnaissance of an area of which Lolgorien Hill approximately marks the centre and was made following applications by a number of claim holders for assistance in their prospecting operations.

The area lies in the South Masai Reserve and is difficult of approach. One road runs from Narok, through Lemek, to the Amara River Bridge, after which it is very badly defined: the journey should not be attempted without a guide.<sup>1</sup> Another route is through Sotik and down to the Gori River by Major B. F. Webb's mine road, passing through Kilgoris: close to the Gori River, a well-defined road comes in from the left, or east, and the turn left should be made here; the Gori is then crossed where it turns north by means of a steep drift and it is advisable to examine its condition before attempting the crossing. Lolgorien Hill lies eight miles east of this drift and there the road joins the track from the Amara.

The boundaries of the area are approximately defined by the Masai Reserve Boundary to the west; by the Ol Doinyo Longaria Escarpment to the east; by the Tanganyika Border to the south; and by the lava-capped country extending eastwards from Longawone Hills to the north. One station of the Anglo-German Border Survey is found within the limits of the map: it is—

Sigaa—S. Lat.  $1^{\circ}8'21''$ .

E. Long.  $34^{\circ}44'11''$ .

Height above mean sea-level: 6,101 feet.

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<sup>1</sup> For the more adventurous, the following mileages and landmarks may save a night in the bush: Mileages from the Amara Bridge: 14.8 m., dry watercourse, bad drift; 23.5 m., turn sharp right, leaving old road; 28.5 m., blazed tree, turn sharp left; 30.3 m., narrow swamp; 31.4 m., narrow swamp; 32.7 m., old *manyatta*, turn sharp left; 34.4 m., descent through forest; 37.5 m., store.

# THE LOLGORIEN AREA

By R. MURRAY-HUGHES, A.I.M.M., F.G.S.,

*Geologist*

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## **HISTORY OF DISCOVERY.**

The field was originally discovered in 1920 by Mr. Caldwell, a qualified mining engineer, who was passing through the country on a general prospecting trip. Having obtained encouraging results from the panning of the many streams, he followed these indications with the usual surface prospection and found a promising outcrop. Caldwell was fortunate enough to capture the interest of the late Sir Northrup McMillan and he provided the necessary capital for the development of the field up to the time of his death. After that no further capital was forthcoming for pure development. This, however, was continued from the proceeds of crushing a portion of the already developed ore reserves. At the end of 1923 it was obvious that pumping plant would be necessary and further development was discontinued for the time being.

Since then a little work has been continued in the area by one or two individuals, with quite good results, but general interest in it had dropped until it was renewed recently by the discovery of the sister field of Kakamega.

## **RELIEF.**

The whole district is underlain by highly altered igneous and sedimentary rocks, or by later igneous rocks intrusive into them. The most important of the igneous rocks is the Butende Granite, and the northern contact of this mass divides the country into two. The older rocks lie in the northern section and in places form outstanding ranges of hills rising to over 6,000 feet, but the average local grade level is nearer 5,000 feet.

In the south, the granite forms rolling grass country with a few outstanding "kopjes". Both from the north and from the south, the country has a general slope to the Gori River and its tributary, which continues in a south-easterly direction, and the general relief is typically that originating in river erosion.

*River System.*—The main line of drainage runs from south-east to north-west and is fed by numerous lateral streams. A well-defined system of joints in the granite controls the course of the streams in the south, and the foliation of the older rocks combined with a system of fractures running roughly north and south have controlled those in the north.

The topography is typically that of a dissected peneplain and this old surface must have at one time extended unbroken from the Longawone Range across to the Tanganyika Border. It is plainly seen from the top of the Lolgorien Hills and appears as a quite level horizon to the west and south, rising slightly to the north and sinking to the east. Many of the hills to the north, west and east, are capped by lava, the base of the flow being about 5,750 feet above sea-level, and the top 6,100 feet, so giving a minimum thickness to the flow of 350 feet.

## GEOLOGICAL RELATIONS.

### IGNEOUS ROCKS.

*Granite.*—The principal igneous masses are those formed by the Butende Granite south of the Gori River and by the Longaria Granite east of the area. It is not certain that these two form part of the one intrusion. The Butende Granite, where it approaches the contact with the older rocks, shows profound changes within its mass, the general tendency being towards the formation of a more basic rock. In favourable areas, a passage from the unaltered acid granite through to syenite and diorite may be observed. South of Lolgorien Hill, it is devoid of free quartz and presents a gneissose appearance due to the stringing out of laths of hornblende into parallel bands, which, curiously enough, are oriented north and south, and so normal to the actual field contact. The hornblende shows all stages of alteration to epidote and the green colour of this mineral gives the rock a very striking appearance.

The Longaria Granite shows no unusual features. It is of medium-grained texture, and pale pink in colour. Its mineral composition is made up of quartz, orthoclase felspar, hornblende, biotite, sphene, epidote, and pyrite. Biotite is not abundant; sphene is intergrown with the hornblende. Surrounding each cluster of hornblende is a pale greenish

stain, and rarely, epidote may be seen in small crystals within the clusters. Pyrite occurs as minute "pin-head" crystals in some specimens but is not seen in all. The specific gravity of the rock averages 2.7.

*Granite Porphyry.*—This is found to the north of Lolgorien Hill. Unaltered, it is a leucocratic rock, pale green in colour. Quartz forms fairly abundant phenocrysts; hornblende is less common, but as part of a second generation with biotite, it is fairly plentiful, scattered through the rock in crystals of less than 1 mm. Sphene is also found in its usual, well-defined, lozenge-shaped form. The specific gravity of this rock is 2.74.

In places the granite porphyry appears to pass into a more basic type in which no free quartz appears. The phenocrysts are of saussuritized feldspar and the rock has the general appearance of a "rhomb porphyry".

*Diorite Porphyry.*—Another rock found in the same area is a medium-grained, leucocratic rock of dioritic composition. It contains no quartz, but is composed mostly of plagioclase feldspar with scattered crystals of hornblende. Pyrite is found again as small "pin-head" crystals.

*Felsite.*—Finer-grained rocks are more difficult to determine and describe merely from megascopic examination, and some cannot be classified until they are examined microscopically. Of this type are the felsites and lamprophyres, both of which occur in the area.

Outcropping along the south bank of the stream north of Lolgorien Hill, and apparently intrusive into the granite-porphyry, is a quartz-felsite. It is a light brown rock in which the phenocrysts are of quartz, some of which show the usual hexagonal form, but some of which are corroded and rounded. The ground-mass is a pasty growth of feldspar in which rare crystals of red orthoclase (?) may be seen and characterize the rock. It is quite fresh and good specimens are easily obtained. The specific gravity varies from 2.65 to 2.7.

A rather similar rock but of still finer grain is found in the old adit at the Red Ray claims two miles to the east. It is, however, very decomposed.

*Lamprophyre.*—On the dump at the same workings, a dark, heavy chloritic rock (specific gravity 2.9) is found and

may possibly be the alteration product of one of the lamprophyre family (Kersantite). Minute specks of pyrite are scattered through it and inclusions of the banded ironstone, up to one inch in diameter, are also found in it.

To the west, on the far side of the stream north of Lolgorien Hill, two other interesting intrusives are found. The first is a rock of curious, mottled appearance derived from greenish laths of chlorite (after hornblende?) in a reddish, finely crystalline matrix (specific gravity 2.66). This may also be an altered lamprophyre.

*Lava.*—Finally, the most recent phase of igneous activity is represented by the lava, a nepheline phonolite, that caps the hills and plateau to the north and east of Lolgorien, and which has been mentioned previously.

### SEDIMENTARY ROCKS.

*Banded Ironstone.*—Lolgorien Hill and the range that extends east and west of it are composed of a "Banded Ironstone" which may be of sedimentary origin. Its environment is peculiar, however, for it is bounded north and south by the porphyritic rocks described above, and its relationship to these rocks in depth is still unknown.

Where this rock is unaffected by surface weathering, it is dark green in colour, fine-grained, crystalline and banded, but this last feature is not so conspicuous as at the outcrop. The hand-specimen only shows quartz, magnetite, hæmatite, and specks of pyrite as the constituents (specific gravity 3.08). It is veined with quartz, and in some cases the small (1 mm.) veins follow faults which displace the banding and separate it by a centimetre or more. In the oxidized zone the rock is very distinctly banded, the bands being of light-coloured quartz or chalcedony (jasper?), and of varying coloured iron-oxides which differ in colour according to their degree of hydration. Some of the iron bands are light to dark brown; others are red. In some places the iron is in the form of hæmatite and has been sufficiently concentrated to constitute an iron-ore rich enough for the natives to smelt, and the remains of a furnace marked by a heap of slag was found on the northern flank of Lolgorien Hill.

In an adit on the Red Ray claims the Ironstone was found to thin out a good deal and to form bodies of only a few inches wide, tapering, wedge-like, into a sheared felsite porphyry.

In Southern Rhodesia, certain of the "Banded Ironstones" have been shown by the Geological Survey to be derived from the extreme alteration of felsite and it is just possible that certain parts of the Lolgorien Banded Ironstone may have a similar origin, but a much more thorough investigation is necessary before this could be demonstrated. It is an important point, however, owing to the common association of gold with felsite intrusions.

*Conglomerate.*—This was not seen *in situ*, but is said to outcrop to the north-west of Lolgorien Hill. Loose blocks of it were found, however, in the Gori River where that river takes its turn northwards. It appears to be the same as that which is found in other parts of South Kavirondo and as descriptions of it will appear in publications concerning that area and it has no direct bearing on the area covered by this report, no further mention will be made of it. It is undoubtedly of sedimentary origin.

### **METAMORPHISM.**

The full extent of the metamorphism imposed on the intruded rocks is impossible to gauge without further investigations in the field and in the laboratory, but certain changes may be readily seen.

The porphyritic rocks north of Lolgorien Hill, for example, show a gradual transition from typical, medium-grained igneous rocks to chlorite-schist. The first stage, seen as these rocks are traversed southwards, is the development of incipient foliation indicated by the "fissile" character of the outcrops. On the faces of the "slabs", sericite, a form of mica as fine as the dust on the wing of a moth, is formed. The felspar phenocrysts appear granulated and also show sericitization.

The next stage appears as a massive but faintly banded rock in which the bands are formed by definite shear planes along which chlorite has formed.

With an increase in the number of shear planes, the rock finally becomes thoroughly schistose and is a chlorite-schist.

Quartz veins are found in all these types, and in Figure 1 a specimen from the footwall of a vein occurring in stage two is illustrated. It shows the subsidiary veining of the wall by quartz and siderite, and the "peppering" of the rock with pyrite.

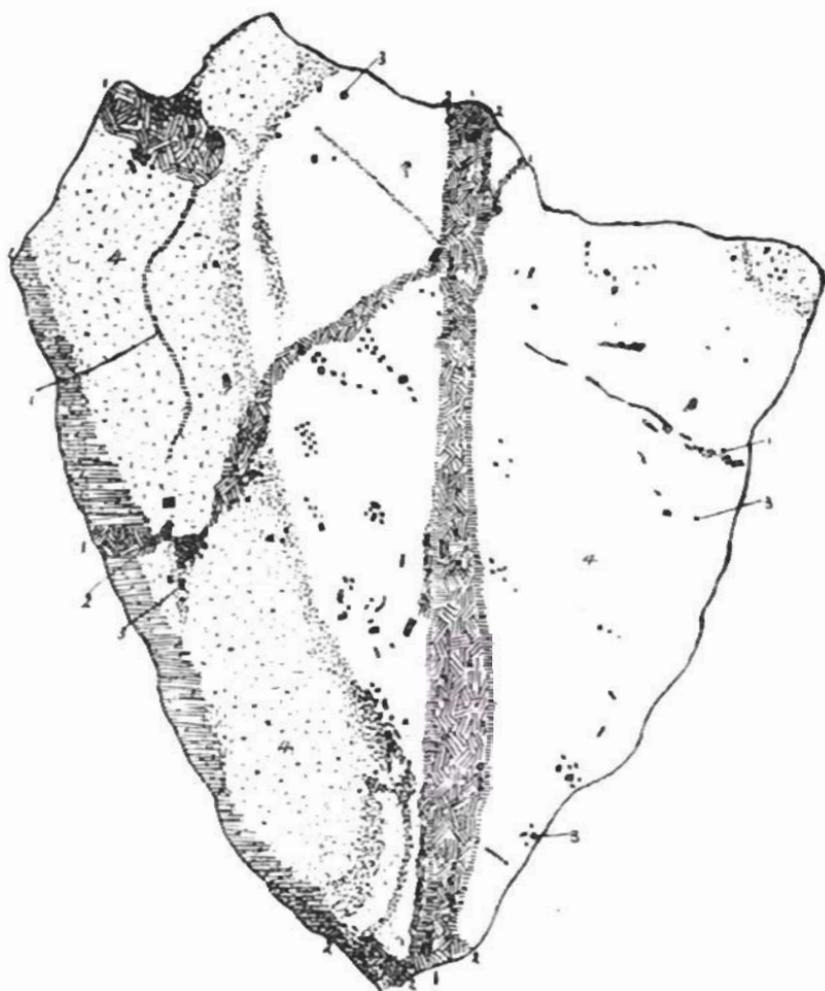


FIG. 1.—1=Quartz; 2=Siderite; 3=Pyrite; 4=Partly silicified, sheared Granite Porphyry (Stage 2) forming walls of rich vein, 4ft. 6in. wide.

### STRUCTURE.

The general structure of the country is controlled by an important tectonic line which strikes approximately N 70°W to S 70°E. The northern contact of the Butende Granite follows this general direction, but it cannot safely be said whether this is causal or subsequent. In any case, compressional forces have acted along this line and have thrown the older rocks into close folds with axes plunging both to the east and west. Where such forces act on a heterogeneous front there must be resultant fractures normal to the direction of this initial force or at a lesser angle to it. These resultant fractures and drag folds verge towards the north and

south in direction, and a major fault of this class, although developed after an immense interval of time, is probably represented by the Ol Doinyo Longaria Fault, which strikes north-east-south-west, and is, therefore, a dip fault.

As far as it has been possible to discover, the earlier quartz veins in the area have taken part in this diastrophism and are also folded and faulted. Generally simple in conception, locally, folding and faulting may lead to great complexity of structure, and to the uninitiated, lead to the abandonment of claims owing to the disappearance of the reef; but in most of such cases the structural problems involved are readily solvable after careful field work and mapping.

The general strike of the "country" is a little north of east and south of west and a great number of the quartz veins follow this direction. It may be stated here that in a virgin field no rule can be stated concerning favourable strike directions. As development progresses, a local and empirical rule may evolve, and it may be found that veins following a certain direction are more favourable for prospecting than any of the others, but in new country "anything may carry anything."

Certain massive rocks under stress do not yield readily to folding, but develop joint planes. At the contact of the granite with the older rocks, for example, the following series of joints are developed within it:—

N 35°W-S 35°E	} all approaching verticality in dip.
N 70°E-S 70°W	
N-S.	

These directional lines vary within the mass itself and, indeed, by the study and mapping of them, the original shape of such an intrusion and the direction from which it came, may be deduced. For guidance in prospecting their determination may be of great importance.

Locally it is found that the pegmatites, certain quartz porphyries, and lamprophyres, tend to follow the N-S direction, but not sufficient evidence has been collected to state this as a general rule.

#### **WEATHERING.**

Owing to the comparatively juvenile stages at which weathering has arrived, there is no great secular decay and the overburden is not heavy. Bed-rock outcrops in the rivers and on the slopes and, where it does not do so, may be exposed by shallow trenching. On the other hand, evaporation

has kept pace with precipitation and this has resulted in the formation of laterite on the less steep slopes, or, as it is more commonly known in Kenya, "murram". The process of lateritisation involves the chemistry, organic, inorganic, and colloidal, principally of the elements, iron and aluminium, but the simplest case is stated by saying that these two elements, which are universal constituents of rocks, are taken into solution by natural acids to form unstable salts which are very readily oxidized and then become stabilized and "fixed". For so long as the unstable salts of these elements are kept in solution they may be carried away, but if evaporation is rapid, the salts are oxidized and precipitated as various stable hydrates and these form the binding material in laterite. Any rock fragments, pebbles, minerals, and other substances lying on the surface at the time, are engulfed and bound by the rapidly setting iron and aluminium oxides.

It is obvious, therefore, that where mineral-bearing lodes are in the process of disintegration, the more resistant constituents may be caught in the laterite and arrested in their normal travel downwards towards the streams, where, under other climatic and topographical conditions, they might have formed alluvial deposits.

Gold and quartz are two of the most resistant of all minerals and it is possible that in the Lolgorien Area a few of the many deposits of laterite may be found to contain gold and gold-bearing quartz in sufficient quantities to be worth exploitation and so form a source of revenue to help towards the development of "reef" claims.

There is another aspect of the formation of laterite. Where bodies contain any quantity of pyrite or arseno-pyrite, as some of the Lolgorien veins do, the iron released by the oxidation of those sulphides may form a laterite cap over the lode and so conceal it. Such a possibility should be borne in mind by prospectors.<sup>1</sup>

### **GOLD QUARTZ VEINS.**

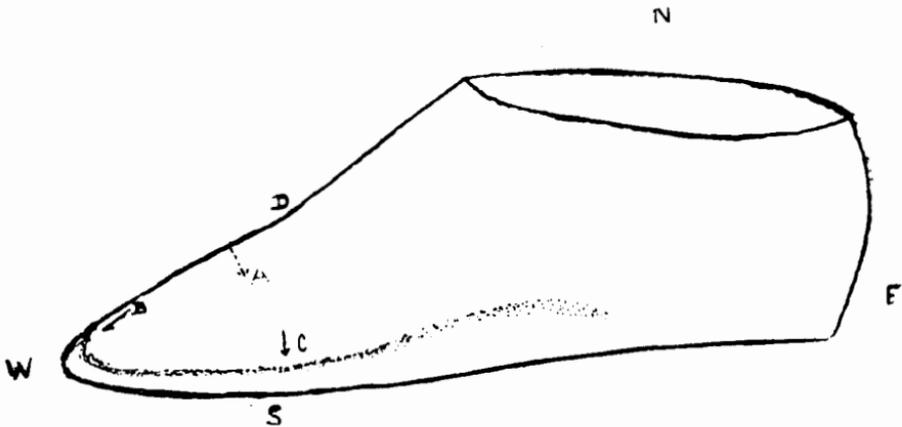
The quartz veins, where they do not outcrop, are readily found by the indications supplied by quartz float that lies on the surface, or which may be present in patches of laterite. Those veins which were seen show little evidence of alteration, erosion having kept apace with oxidation. In form, many correspond to that of the typical "fissure-vein" and a number are strong bodies between parallel walls showing little tendency

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<sup>1</sup> This should not be confused with the "iron-cap" or "gossan", which is lode weathering *in situ*.

to lenticularity of habit. Others show an inclination to " pinch and swell ", and this appears to be a feature of the later and smaller veins which strike north and south, although insufficient data have been obtainable to state this as a rule.

Those veins which strike east and west have a prevailing dip to the south, but as some of them are folded with the " country ", an opposite dip may be found where the surface cuts the northern limb of a fold. Further, as the axes of the folds " pitch ", that is to say the folds themselves show an inclination to the east or west, an infolded vein may show a dip to any direction of the compass when followed round the " toe " of the fold.



If a vein is considered as being part of a fold in a similar way to the strip of material covering the toe of a shoe, it will be seen that if the shoe is oriented west to east with the toe dipping or " pitching " to the west, the material at A, on the opposite side of the toe, will dip to the north; at B, it will follow the pitch of the toe and dip to the west; and at C, it will dip south, or towards the reader; at D, the outcrop will be almost flat, occupying a comparatively great surface area.

Most of the veins already found lie in the belt of schist, the altered form of the porphyry that lies farther to the north, but veins have been found well inside the granite and well inside the unshered porphyry.

Detailed information cannot be given concerning the individual deposits that are now being developed. In the initial stages of development prospectors are not always anxious to make public their results, and although information was given freely, not all was intended for publication.

The " east and west " veins carry quite abundant pyrite, blende, and galena, and a peculiarity is that many, in spite of such a heavy mineralization of the outcrop, do not carry a trace of gold. On the other hand, others are richly auriferous, and it may be a freak of nature and due to processes of erosion that the barren portions of such veins outcrop, whereas richer parts, or shoots, lie buried.

If then, an obviously " mineralized " vein is found and on testing by assay is found to be barren, hope should not be abandoned until the intermediate areas along the strike and between outcrops have been explored by means of trenches or pits.

### **RECOMMENDATIONS.**

The rough map that accompanies this report shows the area particularly promising and where useful discoveries may be made. The streams between the Dolgorien Range and the Kavirondo Reserve Boundary all carry detrital gold in small quantities which, as has been indicated under the head of " weathering ", is all to be expected under the particular weathering conditions, but for all this apparent paucity may indicate good deposits lying farther to the north.

The country to the east should also be carefully prospected embracing an area at least two or three miles north of the granite contact and a mile within the granite.

It is said that gold-bearing veins are never found in granite. This is an absolute fallacy, for many hundreds of gold-bearing veins all over the world are found in granite. It is true that they are not found more than one-half to one mile from a " contact ", but one may be standing on granite that extends for many miles around one and still be less than half-a-mile from a " contact "; the contact being that which formed the " roof " and which has been denuded.

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