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GEOLOGICAL SURVEY
OF
No. 2 MINING AREA, KAVIRONDO
Interim Report and Map of the South-West Quadrant

by
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Assistant Geologist

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I—INTRODUCTION

The area described in this report comprises the Sakwa Location and part of the Asembo Location of Central Kavirondo. It is bounded on the north by the River Yala, on the east by a true north-south line running through a point about 0.4 miles east of Anyango T.S., 1 on the west by the shore of Lake Victoria, and on the south by the shore of the Kavirondo Gulf and a line running across the base of the Uyoma Peninsula. The area, which forms the South-West Quadrant of the No. 2 Area of the Kitson Report (8) 2, is approximately 230 square miles in extent. The whole of the area is included in the Karungu Sheet, Africa, South A 36/E, published in 1916 on the scale of 1:250,000.

FIG. 1
Sketch map of North and Central Kavirondo, Kenya Colony, showing the position of No. 2 Mining Area. The South-West Quadrant, dealt with in this report, is shaded.

1 T.S. (s) = Trigonometrical Station(s).
2 Numbers (1) to (21) refer to literature listed under section VIII “Bibliography”.
The topography and geology of the present map are based on the secondary triangulation of Central Kivirondo carried out by C. T. Cogle in 1935. The country was surveyed by a series of north-south traverses at two mile intervals, special short traverses with various orientations being made to cut the margins of the Asembo, Abon and Abiru granites. In addition, roads and tracks usable by motor vehicles were surveyed. All other detail was obtained by sketch mapping.

From the geologist's viewpoint the area is variable good and bad. In certain parts, notably the slopes near the River Yala, the southern granite areas, and some areas in Sakwa, rock exposures are prolific. In other large tracts, however, often several square miles in extent and usually on the flat divides of eastern Sakwa and western Asembo, exposures are either very rare or absent, and geological evidence is restricted to loose blocks lying about the surface. Throughout the area critical exposures—junctures and contacts—are extremely rare.

The area is well supplied with roads and car-tracks, especially in south-western Sakwa, yet large tracts are at present accessible only on foot. In the western part of the area access is rendered all the more difficult by the frequency of dense thorn bush or dwarf forest. South-east of a line passing through Abem, Gangu, Nyagoka, Abiru T.Ss. and Ngula Hill the country is usually open and easily traversed. In the remainder of the area thick bush frequently clothes the flat ridges, though the valleys are usually grass-covered, and glades and large areas of cultivation occur among the bush. It is only in the eastern portion of the area that cultivation is extensive, though even there it occupies only a relatively small proportion of the country.

Finally, it may be remarked that the gold production of this section of the No. 2 Area has been relatively high and has increased considerably during 1937. Several properties now show promise of becoming established producers, whilst it is evident that the possibilities of other portions of the area have been by no means fully exploited.

II—PREVIOUS WORK

Prior to the last decade little work appears to have been done in the Asembo-Sakwa area. Gregory (3, 1921) makes no specific reference to it, but on the small scale map (pp. 26-7) shows it to consist entirely of "Eozoic Schist, etc." except Uyoma which is stippled as "Volcanic."
In 1929 Odman (15) published a sketch map showing the south-eastern part of the area to be occupied by granite, and the remainder by "super-crustal rocks", i.e. members of Odman's "Kavirondo Series", consisting, in this area, of members of a group now referred to as the Pre-Kavirondo Volcanic Series.

Odman's descriptions are concerned mainly with districts north or north-east of the present area. He mentioned, however (p. 85), the Kadimo Conglomerate, which has correlates in the Sakwa Area. He remarked that it is unlike the Kavirondo Series conglomerates of the Yala and Kikamega areas, in that it contains abundant chlorite in the matrix. "If it were not for the roundness of the pebbles" states Odman, "it would be taken for an agglomerate".

Five years later Report No. 3 of the Mining and Geological Department (14, 1933) on the geology of western Kenya was published. The map accompanying the report shows the Asembo-Sakwa area to be occupied by the westward extension of the Maseno granites near Asembo, and by a further extension passing under Asembo Bay to Abiru and the Sera-wonga areas. A third granite mass is shown as occupying the northern part between Abom and Ramba. Between the Asembo and Abom granites a strip of pre-Cambrian volcanics, extending north-east-south-west is shown, whilst the remainder of the western and central parts of the area is mapped as members of the "Muva-Ankolean" sedimentary system. The Uyoma Peninsula is indicated as Post-Tertiary sediments (Lake deposits, etc.).'

In the text (p. 4) Murray-Hughes describes a series of pre-Muva-Ankolean volcanic rocks, which he provisionally names the Asembo Greenstones. He remarks that in type they range from rhyolite to basalt, and he compares them with the Ndembera Volcanic Series of Tanganyika. Describing the major intrusives Murray-Hughes points out (p. 5) that differentiation is to be seen near Abom, where "diorite" and "spessartite" grade into the principal granite mass.

Sir Albert Kitson's final report on Kavirondo (9) published in 1934, contains descriptions of traverses along almost all the then-existing roads in the area. Note is made of the Asembo, Abiru and Abom granite masses, of various minor intrusives and of the ancient volcanic rocks. The Pleistocene and Tertiary accumulations near Uyoma are also mentioned.

Brief mention of the Old Volcanic Series, the granites of Asembo and Abiru and the lavas and sediments of the Uyoma
The area is one of relatively low relief, the highest point (Rambugu T. S.) being only 728′ above mean lake level (3,726′ above O.D.). Most of the greater part of the area consists of broad flat valleys and wide divides giving a gently rolling appearance to the country, which is relieved by scattered residual hills, by the rather sudden drop to the Yala River in the northeast and by the plain-like expanses bordering the Lake in the south. Structurally the area is part of the Kavirondo peneplain, which here stood at about 4,000′ up 4,500′ above sea-level with a gentle tilt to the southwest. The peneplain has been incised, though to a slight extent only in this area.

The only perennial watercourses in the area are the River Yala, and a few small streams which, flow into it in the Abon District. Dry valleys, or valleys containing isolated pools of water, characterize the remainder of the area during the greater part of the year. After heavy and continuous rains, however, several of the larger valleys carry freshets of considerable volume. The valleys are broad and flat, with bottoms often thickly mantled by alluvium, and with slopes which rise gently to the flat divides. Valley-capture is naturally not easy to determine in such an area, though the anomalous course of the upper Utonga valley appears indicative of the capture of the western baf of the valley which runs through the Abiru granite mass.

The rejuvenation, so frequently noted in adjacent areas is also difficult to trace, though the upper Nvotime valley (Asumbo) is evidently rejuvenated, whilst the River Yala and its small tributaries show slight rejuvenation. Terraces have been noted along the Yala north of Usiri and the Bondo Police Post.
Evidence of the variation of Lake level is abundant, especially on the southern littorals. Terraces and gravel deposits, occurring to about 100' above present Lake level are common. The Lake area as a whole is an excellent example of drowned topography, marked by the highly indented coastline and the archipelagos (cf. Gregory, 3, p. 262).

IV—SUMMARY OF GEOLOGY, GEOLOGICAL SUCCESSION AND CORRELATION

The oldest rocks in the area are the gneisses and granulites of the Basement Complex occurring on Kayamo Island, etc., and on the mainland near Tedo. They are invaded by granites, which, however, are of "Younger" type and are possibly similar in age to other granites mentioned below. The greater part of the area is occupied by members of the Pre-Kavirondo Volcanic Suite (5, p. 9) here consisting of lavas ranging from acid to basic in type, tufts, agglomerates, and, occasionally, conglomerates. This suite is invaded by several large and small granite masses, especially in the south, and by many minor intrusives of various types. In northern Uyoma the Basement Complex and the pre-Cambrian lavas are overlain by Tertiary volcanics and sediments.

The succession of rocks and events may be conveniently summarized as follows:——

RECENT AND PLIOCENE:

19 Modern denudation, deposition of alluvials, fluctuations of level; denudation of Phasant 1; formation of ironstone cappings (?).

TERTIARY:

18 Volcanics of Uyoma—nephelinite, phonolite, tufts and agglomerates; with melasandite in N.E. Uyoma and near Asembo.

PALEOZOIC TO TERTIARY (?):

17 Long continued denudation and peneplanation accompanied at one stage by the intrusion of dolerites.

AGE UNKNOWN; PRESUMABLY EARLY PALEOZOIC OR PRE-CAMBRIAN:

16 Minor folding. Faulting.
15 Incidence of quartz veining.
14 Intrusion of a few small granitic bosses.
13 Intrusion of acid, sub-acid, intermediate and basic dykes and small bosses.
12 Intrusion of Abiru Granite (Gb1) and possibly of the Asembo and Ndeda Island Granites (G).

1 See 6, p. 8 and map. Gb1 granites are intrusive into the Kavirondo Series. Gb2 granites are believed to invade the Pre-Kavirondo Volcanic Suite only. The sedimentary Kavirondo Series has not been observed in this area; if it were present it would appear in the table between 11 and 12.
PRE-CAMBRIAN:

11 Presumed folding.
10 Some dyke intrusions.
9 Intrusion of the granites—Abor, Teda, Bando, Kayamo Island, etc.
8 Intrusion of some dolerites—now partly or entirely altered to epidiorites.
7 Uplift and folding.
6 Extravasation of basic lavas.
5 Deposition of tuffs, agglomerates and occasional conglomerates.
4 Extravasation of Andesites with occasional trachy-andesite and acid lavas; tuffs and conglomerates.
3 Extravasation of acid and sub-acid lavas with phases of pyroclastic activity and some intermediate lavas.

BASEMENT COMPLEX; ARCHIAN:

2 Folding.
1 Gneisses and granulites of the south-west.
Rocks believed to be of Basement Complex age occur on the mainland in a belt adjoining the Togo granite, and on Kayamo, Seki and Ndeda Islands off the west coast. The types present include garnet gneisses, granulites and microamphibolites. In view of the fact that some lavas of the Pre-Kavirondo Volcanic suite convert to granulitic and microamphibolitic types during metamorphism, the reasons for dating these rocks as Basement Complex are stated below:

1. The granulites are of regional type, with amphibole recrystallized as compact grains.

2. Schistose biotite-amphibole granulites occur in which the biotite is more or less restricted to certain bands.

3. Some of the rocks are gneissose, and contain pink garnet in certain bands.

4. In east Togo the contact of gneissose granulites and granite is well exposed. The vertical banding of the granulites strikes east-west, and the granite cuts across it almost at right angles.

The rocks of the mainland include schistose and gneissose hornblende granulites, and a hornblende-epidote-clinozoisite granulite. The former are dark grey or greenish grey, banded or unbanded, slightly schistose rocks. In the gneissose types the banding is due to concentration of hornblende along certain lines. The hornblende occurs as irregular crystals, forming a mesh, and rather rarely as needles and aggregates. The base is a granular re-crystallization of glass-clear albite, Pinkish brown epidote is rare, and is confined mainly to small faults crossing the schistosity obliquely. The more complex granulite was found as a loose block only on the north-western shore of Uyoma.

The types found on Kayamo Island are:

2. Schistose-hornblende-biotite granulite.
3. Hornblende-epidote granulite (with a small proportion of garnet in certain bands).
4. Garnetiferous gneiss granulite band.

V DETAILS OF GEOLOGY
I. BASEMENT COMPLEX

1. See 6, pp. 27, 28, where aureoles of schistose and granulitised volcanics are described as bordering some of the granites.
The first two are dark grey, fine-grained granulitic types with occasional streaky concentrations of epidote or hornblende. The third is mainly dark grey and granulitic but with epidotic bands containing small developments of pink garnet, whilst the fourth is markedly gneissic with granulitic bands and green and pink bands or lenses containing patches and streaks of garnet.

In thin section the mica-bearing granulite is seen to be schistose. Hornblende, epidote from dark blue-green to a faint bluish-green, is common, trending to aggregate into thin bands. Bioite, pleochroic from dull medium brown to pale brown or colourless, is also common and is frequently intergrown with hornblende; it also occurs in biotite-rich bands. Epidote occurs as infrequent grains and aggregates, and magnetite is present as small irregular grains, often arranged in trains along the schistosity. The base is glass-clear soda-rich plagioclase with some quartz. Small pools of calcite occur rarely.

In thin section the garnetiferous gneiss is found to consist of mélange of garnet, epidote, quartz and calcite interbranded with hornblende-epidote granulite. The garnet is a pinkish-brown variety, occurring in massive form, and has not developed crystal faces except when it projects into quartz pools. It is netted by epidote growths, and is usually restricted to the central portion of the bands, being enclosed in massive developments of epidote.

The rocks of Seki and Ndeda Islands are dark grey fine-grained granulitic types which, however, in this section, are found to be more of the nature of micro-arsenolitites than granulites. These more closely resemble altered lavas of the Pre-Kavirondo Volcanic suite than the above types, but in view of their associates and their occurrence in an area apart from any known basic members of that suite, they are provisionally classified here.

The Seki rock is a fine-grained crystalloblastic type containing abundant matted aggregates of fibrous hornblende. Clinzoisite is common in parts, and spheere and iron oxides are present. The base is recrystallized felspar with some quartz. The Ndeda rock is rather coarse-grained and the hornblende often occurs in large fibrous or compact growths. The fibres are sometimes markedly curved and suggest crystallization under stress. Clinzoisite, epidote and magnetite are also present, whilst the base consists of glass-clear recrystallized felspar.
2.—THE PRE-KAVIRONDO VOLCANIC SERIES

The rocks of this series occupy the greater part of the South-West Quadrant, and comprise types ranging from more basic varieties in the east, through intermediate types, widespread in the central part of the area, to acid and sub-acid types in the west. Pyroclastic rocks are developed in the western and central parts, and along the Yala valley. The succession cannot readily be determined owing to lack of junctions and the impossibility of mapping lava flows as separate entities. On analogy with the northern part of the No. 2 Area (5. and 6) and on the evidence of the nature and succession of the pyroclastic rocks, it is presumed that the basic lavas are here the youngest members of the series and that throughout the area the succession is as follows:

5. Basalts with rare small sub-acid flows in the east, and rare basic tufts.
4. Agglomerates and tufts, impersistent, except in the Yala valley, and conglomerates in the north.
3. Andesite suite. Andesites, occasional trachyanandesites, and rhyolitic flows, and sporadic tufts and agglomerates.
2. Rhyolites and sub-acid lavas with intercalated tufts and agglomerates.
1. Agglomerates and andesites of south-western Sakwa.

The whole series, though less metamorphosed, bears some resemblance to the Musoma (volcanic) Series described by Stockley (18, p. 9, and 19, p. 11; see also 20, pp. 15 and 41). It is noteworthy that in Tanganyika the Basic volcanics are considered to be the earlier members of the series.

For convenience the various types of the volcanic series are here described together irrespective of age.

(a) Rhyolites and Sub-Acid Lavas.

Many of the members of this group are characterized by rather intense decomposition. The more decomposed types are buff and pinky-buff, sometimes creamy or mauve tinted, very fine-grained rocks which are either non-porphyritic or contain small white or creamy felspar phenocrysts and, rarely, small quartz phenocrysts. Less decomposed types are light to medium grey and occasionally possess a greenish or bluish tinge. They are alkaline and fine grained and sometimes contain few or many small vesicles. Flow textures are very rarely seen, and spherulitic lavas are known only in western Abimbo.
The more acid types consist essentially of a fine or medium-grained granular mosaic of quartz and felspar, the latter frequently heavily sericitised, and containing rarely small resorbed quartz phenocrysts. They usually display more or less abundant felspar phenocrysts, rarely greater than 2 mm. long, which are often entirely replaced by packed sericite aggregates or by sericite intergrown with chlorite, quartz and, occasionally, carbonates. They are not infrequently impregnated by limonite, which in some cases pick out the felspar phenocrysts. Hematite or leucoxene are usually present, and in some, small granules of secondary sphene are developed. Calcite and fenhiferous carbonates are often present as small disseminated patches, and in some cases are abundant. Chlorite is fairly common in irregular growths. In a lava near the Lamese camp flakes and crystals of ar. unusual chlorite, pleochroic from a pale blue or blue-green tint to colourless, were noted. Rarely small flakes of actinolite are present, and in one example small nests of acicular riecke are developed. Unaltered ferromagnesian minerals or pseudomorphs after them were not detected in any acid lava sliced. Small flakes and crystals of a pale golden brown biotite were noted in a mottled felsitic rock on the track north-north-east of Bondo, but they are probably of secondary origin. The vesicles of these rocks contain carbonates, quartz and chlorite and sometimes pyrite. Rarely an example occurs on the south flank of Serawonga T.31 small vesicles contain diffuse sericitic cores.

The subacid lavas of dacitic affinities are somewhat similar to the above types, but contain recognizable phenocrysts of plagioclase ranging from oligoclase to acid labradorite, whilst lathy crystals of oligoclase-arfvedsonite make up a varying proportion of the matrix. Pseudomorphs of and, occasionally unaltered ferromagnesian minerals are common present. In a dacite on the southern flank of Abom Hill hornblende is pseudomorphed by calcite-chlorite-epidote aggregates, whilst in an example on the Sakwa road north-east of the Bellamira Properties well-shaped crystals of augite are replaced by chlorite, epidote and calcite. Epidote is not uncommon in these rocks as an alteration product replacing ferromagnesian minerals and occasionally felspars, whilst small development of actinolite also occur. Quartz phenocrysts are rare, though quartz is always present in the matrix. Some of the dacites are vesicular, the vesicles being occasionally large and irregular.
(b) Andesitic Lava.

The intermediate lavas vary considerably in composition and degree of alteration. They range from quartz-andesites through normal andesites and trachy-andesites to basic types which are almost basaltic. They are usually porphyritic with abundant small, whitish, or rarely grayish, feldspar phenocrysts set in a fine-grained grey matrix in which small dark mafic crystals may or may not be visible. The phenocrysts rarely exceed 2 to 3 mm. in size, but occasionally occur up to 5 to 6 mm. Non-porphyritic types are rare. Flow brecciation and flow structures have been observed at a few places, e.g. Abimbo, whilst propylitization of andesitic types is common in the north-western part of the area. The lavas are variously vesicular or non-vesicular but vesicular types are very frequent. The vesicles commonly appear to be infilled by mafic or purple carbonate.

When decomposed the andesites are usually brown with small white felspar crystals, whilst in extreme cases they are reduced to soft, buff, almost indeterminate rocks. Less decomposed types are usually dark to light grey, and frequently have a greenish, bluish, or occasionally mauve tint. They present a very fine-grained, sometimes almost glazy appearance, but at other times are finely granular. Propylitized types are blotched or streaked by creamy or light green patches. Veining is frequent, the veins containing variously quartz, quartz and epidote, quartz and calcite, quartz and sericite, chlorite and calcite, calcite, calcite and pyrite, and calcite with pyrite and quartz.

Quartz andesites are rare, and only two examples were noted in the area. One, occurring a little southwest of Chassu camp, has rare quartz phenocrysts and a small proportion of interstitial quartz. Andesite occurs as phenocrysts, and the matrix is a porphyritic matrix of oligoclase-andesine laths associated with chlorite, sericite, carbonatic, and secondary sphene. The second, from the Chassu track north-north-east of Nangu, has no quartz phenocrysts but quartz, apparently primary, is not uncommon as small irregular pools in the matrix. Oligoclase-andesine phenocrysts are abundant, whilst the matrix contains many laths of medium oligoclase with trachytic arrangement, associated with chlorite, carbonate and magnetite.

The andesites, in thin section, are usually seen to be porphyritic with variously abundant felspar phenocrysts, which not uncommonly occur in leucoporphyritic groups. The felspars range in type from oligoclase to acid leucotriose,
While in some members occasional orthoclase phenocrysts are present. These feldspars are rarely fresh and alteration and complete replacement are common. The alteration products include sericite, calcite, chlorite, epidote, zoisite, clinozoisite and quartz. Unaltered ferroanagnasian phenocrysts are rare, though in a few cases pyroxene phenocrysts have been preserved, and, in one case only, amphibole phenocrysts. Pseudoforms of pyroxene composed of chlorite, carbonate and epidote, sometimes associated with actinolite needles, and of serpentine and chlorite with calcite stringers, are somewhat more common. In most cases, however, no trace of original mafic minerals remains, and they are represented by widespread chloritization, carbonation and, occasionally, epidotization of the rocks. Where pyroxene occurs as phenocryst it is usual to find small crystals of a second generation in the matrix.

The matrices are variable owing to alteration, but normally consist largely of a pilotaxitic, occasionally ortho-phyric, felt of felspar prisms or laths. The felspar ranges about oligoclase-andesine, and rarely andesine, though in some cases it is albite following an albition. The laths and prisms range in size from 1/6 mm. to 1 mm. in length in different types and when near the larger limit give an almost hypabyssal appearance to the rock. In more altered varieties, traces only of the original pilotaxitic arrangement remain, and the matrix consists of an irregular, granular crystallization of albic felspar associated with the decomposition products of the ferroanagnasian minerals. Not infrequently the carbonate of the latter crystallizes in rhombs, which occasionally are of such a size as to give a pseudo-porphyritic appearance to not-porphyritic types. In more acid varieties, e.g. at Abimbo, the matrix is a finely granular devitrification product, in which spherulitic textures are frequent. Other minerals appearing in the matrix are secondary quartz, sericite, occasional magnetite, leucogranules of secondary sphene, epidote, clinozoisite, small proportions of actinolite, and occasional apatite. Pyrite occurs sporadically. Small and sometimes large (to 1 inch) primary vesicles are present in many of these rocks and contain various associations of calcite, chlorite, quartz (in some cases replacing chaledony), epidote, zoisite, and occasionally pyrite and sericite. Irregular "vesicles" produced by the infilling of contraction cracks are not uncommon, and an appearance of vesicularity is frequently given by segregations of carbonates and chlorite, liberated during alteration of the ferroanagnasian constituents.
Non-porphyritic andesites are not common. In some
there is a tendency for the plagiocratic laths of felspar to grade
to rather large size, so that some crystals might almost be
regarded as sub-phenocrysts.

The trachyanadesites resemble the normal andesites but
contain a fair proportion of alkali felspar among their pheno-
cryysts—in some cases in excess of the soda-lime felspars.
Non-porphyritic varieties contain a notable proportion of
orthoclase interstitial to the plagiocratic phenocrysts. Such
types are uncommon and have been found as small develop-
ments only.

The more basic varieties of andesite are of restricted
occurrence and have been found bordering the tongue of
basalts in the Abimbo area and in the basal area north-east
of Tedo. They are commonly vesicular, rather dark, freely
porphyritic rocks, differing from the normal andesites in con-
taining little or no chlorite and carbonates, but with small or
marked developmen of actinolite is acicular, sometimes
stellate, aggregates. In some types, dull or weak brown bio-
tite, pleochroic to pale green and, presumably, of metamorphic
origin, occurs as scattered flakes or aggregates, occasionally
densely concentrated. In these rocks the felspar phenocrysts,
which range in different specimens from oligoclase to labra-
dorite, are commonly partly replaced by epidote.

(c) Basalts.
The basic lavas display less variety and consist of simpler
mineral assemblages than the intermediate lavas. They
occupy the greater part of the Asemblo location and extend in
long arms west-south-west of the main outcrop to Bondo,
Abimbo and Tedo. Porphyritic and non-porphyritic varieties
occur, though the latter predominate except in the south-west.
They are usually fine-grained dark grey rocks, often possessing
a greenish tinge, and, when porphyritic, carrying few or many
whitish felspar phenocrysts which occasionally attain a size
of ½ inch. The more freely porphyritic varieties resemble
andesite in hand-specimen, but examination under the micro-
scope reveals their high content of actinolite and betrays their
more basic nature. The fine-grained varieties frequently
break with a sub-conchoidal fracture. Veining is not so
common as among the intermediate lavas, but chlorite-calcite,
antilolite, and clinozoisite-actinolite veinlets occur. Rarely,
e.g. about 1 mile west of Ramba cross roads, the rocks are
given a streaky appearance due to the presence of greenish
veinlets and segregations containing clinozoisite or clinozoisite
and actinolite. Primary veinlets are rare, except in occasional
flows in Abimbo. The minerals present in the vesicles are variously quartz, calcite, chlorite, zoisite, epidote and combinations of these minerals. Secondary minerals are also rare; the most interesting examples seen occur in the lava at the granitic contact about 2 miles west of Asembo, in which large irregular aggregates of quartz, epidote, clinozoisite, a pale garnet and calcite are developed, and presumably owe their origin to metamorphism by the Asembo granite.

For convenience these lavas are referred to as basalts, though owing to alteration there is little hope of exact identification. Most, especially the non-porphyrctic varieties, are now virtually micro-amphibolites. It is rare that original felspar remains and much is completely albitized. In this, and in the not uncommon occurrence in large outcrop of rude pillows, the rocks bear certain resemblances to spilites (cf. Odman, 15, p. 84). The spaces between the pillows are now commonly filled by quartz and, in the case of a lava in the valley three miles north of Asembo Camp, by intergrowths of zoisite, actinolite and epidote. It is interesting to note that Stockley (19, p. 12) records the presence of pillow lavas among the basic lavas of the Musoma Series in Tanganyika and compares them with similar lavas in the Greenstone Schists of the Basement Series of Southern Rhodesia.

In thin section the basalts are relatively simple rocks. The felspar phenocrysts are always highly altered, being replaced by aggregates of zoisite, epidote and sericite, sometimes associated with actinolite. Ferromanganese phenocrysts are rare, and again, always pseudomorphed, being replaced by aggregates of actinolite and clinozoisite, chlorite and clinozoisite, or by actinolite alone. The matrix of porphyritic types, and the rock as a whole in non-porphyrctic types, is usually highly recrystallized, and consists of a dense matrix of fibrous actinolite crystals and needles, often associated with epidote or clinozoisite, set in a base of glass-clear recrystallized felspar. Traces of felspar laths rarely remain, and in one case only was it possible to determine the relict felspars as medium labradorite. Small pools of secondary quartz are not uncommon, whilst small granules and aggregates of secondary sphere are usually present. Sericite occurs occasionally, whilst chlorite is somewhat more common, occurring in small irregular pools. Calcite is rarely present. Iron ores are of irregular occurrence, sometimes frequent, sometimes rare or absent. Many of the basic lavas are lightly pyritized. Biotite was noted in a specimen from the Abimbo area, but is presumably an anamorphic mineral.
The fragmental members of the volcanic series occur at several horizons in the acid and intermediate lava suites, but are extremely rare in association with the basic lavas (c.f. Odman, 15, p. 14). They include agglomerates, tufts of various types, breccias and conglomerates. The breccias are of very restricted occurrence.

Agglomerates are fairly widespread, and occur in small and large lenticles, a notable example being that about 2 miles south-west of Abom T.S., which has a strike extent of about 2 miles and a maximum width of about ½ mile. They are all very similar in character and are coarse-grained, ill-graded rocks with abundant large fragments, ranging in different occurrences, from 1 inch to 9—10 inches in diameter. The fragments are usually angular, but occasional sub-rounded or well-rounded pebble-like fragments are found. The larger fragments consist mainly of types of andesitic lava and sometimes of tuffs. Occasionally small fragments of granite occur, but are rare. Broken felspar crystals are common in the matrix, whilst pyroxenes are occasionally present. The matrix is frequently highly chloritized and calcitized or impregnated by epidote growths and is sometimes made up entirely of these secondary minerals.

Conglomerates constitute the remaining coarsely fragmental rocks of the volcanic series. They are found as small developments in the Yala valley in the extreme north-east corner of the area, north-north-west of Bondo, and about ½ mile north of Uaire T.S., the only large occurrence being a lens extending for about a mile on the Kadimo Road, 7½ miles west-north-west of Bondo. These rocks are of particular interest, as they invite comparison with the conglomerates of the Kavirondo Series (6, pp. 11, 12 and 6, pp. 17, 18). They appear, however, to be part of an entirely volcanic series, as in the Kadimo Area (17, pp. 13—14), and are regarded as water-worn facies of the pyroclastic rocks representing short periods of time during which volcanic activity ceased locally and shallow water resulting of the tuft and agglomerates occurred. The conditions envisaged are comparable with those which existed in inter-volcanic periods during the Old Red Sandstone volcanic epoch in Scotland (11, p. 129).
The three conglomerates first mentioned above occur as very small lenses. They consist of sub-angular and rounded pebbles, rarely more than 3-4 inches in diameter, of sub-acid and intermediate lavas, and, in the case of that north of Bondo, of hornblend porphyrite in addition. The proportion of matrix is low and consists mainly of secondary quartz, chlorite and calcite. The conglomerate north of Usire is notable insofar as it contains rare pebbles of a granite similar to the Ga Niarodi type (see page 25). The conglomerate south-west of Usire is somewhat coarser than the others and contains rounded and sub-angular pebbles ranging up to six inches or more in diameter. The pebbles consist mainly of very altered porphyritic and non-porphyritic andesites, tufts and felsites, the latter usually small and angular. Very rarely small fragments of graphic granite are present. The matrix contains angular quartz fragments, crystals and fragments of altered felspars, and small rock fragments set in secondary growths of quartz, sericite, chlorite and calcite.

Tuffs.—The finer-grained pyroclastic rocks occur especially in a belt running along the Yala River from east of Abom to north of Usire and then south-west towards Utonga, but failing near the Kadimo Road. Others are of restricted occurrence, mainly in the northern, central and western parts of the area. In type they range from crystallo-lithic tuffs, in which comparatively large rock fragments sometimes occur and provide a link with the agglomerates, through crystal tufts, to rare vitric or pumice tufts. The fragments of the lithic tuffs consist largely of intermediate lavas though occasional fragments of more basic types occur. The latter include rare variolitic types, unlike any of the basic lavas found in Asembo and southern Sakwa. They may indicate a still older series of basic lavas not yet discovered in this area. The crystal and crystallo-lithic types make up the greater part of the tuff occurrences. In the north-west and west, notably near Usire, Utonga and Kadimo, they are frequently quartzose, containing unrounded quartz crystals or angular quartz fragments—not infrequently in long slivery shapes—and are comparable with the quartzose tuffs of the Kadimo area (17, p. 146). Elsewhere quartz is an uncommon constituent, and the tufts are characterized by their considerable alteration, and, especially in the Yala valley, by frequent intense chloritization and carbonation, which, although rendering them difficult subjects for microscope examination, provide a ready distinction from the lavas. Some of the tufts are
less altered and contain crystals and fragments of ferro-
magnesian minerals, usually monoclinic pyroxene. Occasion-
ally the tufts are vesicular, e.g. that on the Bondo—
Uyoma road about 3½ miles south of Bondo. More basic
tufts, of lithic type, have been observed only underlying the
basalts in eastern Abimbo, and as xenoliths in the marginal
quartz diorite of the Asembo granite, 2½ miles west of Asembo
Camp.

Vitric tufts are rare and were found only on the higher
parts of Serawongo and in a small outcrop on the Port-South-
by road about 3½ miles south-west of Bondo. Both are con-
siderably altered and have suffered much migration of chlorite,
carbonate, etc., but in both vitric and semivitric rocks
this can still be recognised.

\[(e)\] Conditions of Deposition of the Volcanic Rocks.

It is not possible, with the evidence available, to de-
termine accurately the conditions under which the lavas and
pyroclastics were formed. The presence of conglomerates, and
pillow-lavas among the basic types, suggests that the area was
probably covered in part by shallow water and was possibly
an archipelago in which the islands may have been formed
around volcanic foci, each building up its separate pile of
volcanic material. The foci are now difficult to determine,
though the larger occurrences of agglomerates south-west of
Abon, south and south-west of Bondo, west of Abimbo, and
south-east of Chausu probably indicate the proximity of
eruptive vents. The propylitization of the lavas in the north-
west is perhaps also indicative of proximity to a volcanic
centre. The area west of Abimbo with its successive lenses
of agglomerate, and Abimbo itself with lava types ranging
from very acid to basic, are particularly suggestive of volcanic
centres.

Whether the basic lavas were also poured from the
supposed vents situated in the north, central, and western parts
of the area is a controversial point. Basic fragments are
comparatively rare in the pyroclastic rocks of the remainder
of the area, and there appear to be no basic plugs which
could be connected with the basic lavas, and no data are
available concerning the direction of attenuation of the series.

3.—Note on the Kavirondo Series

Sediments of the Kavirondo Series have not been identi-
fied in this area. They are, however, widespread in the
northern part of the No. 2 Area and have been described by
Dr. C. S. Hitchen (5, pp. 7—10; 6, pp. 14—20).
4.—TERTIARY

Rocks of Tertiary age have been found only in the southern part of the area, at the neck of the Uyoma Peninsula and a little west of Asembo. Outcrops are scanty and no attempt has been made to map the distribution of the types found, especially as over much of the area the Tertiary rocks are covered by superficial deposits. The boundary shown on the map is the northern limit of the area in which outcrops and abundant blocks of Tertiary rocks are present. The succession is doubtful, but appears to be—

2. Agglomerate and tuffs.
1. Sandstones.

Limestones have not been seen in the area mapped, but are said to occur, often highly contorted, further south in the Uyoma peninsula. It is also reported that fossiliferous marly sediments were found in trenches, somewhere south of Abiru, but these have not been seen by the writer.

_Sandstones_ occur in a bluff underlying a Pleistocene lake terrace, about one mile west of Asembo Bay, and on the lower slopes facing the lake, east of Uyoma Camp. The former, believed by Archdeacon Owen to be of Miocene age, is a yellowish-buff, semi-incoherent, coarse sandstone, with average grain size about 2 mm. The grains include abundant fragments of quartz, dark minerals and rock fragments, some of obsidian-like types. A bromoform separation of the heavier constituents was made with the following result:

**Magnetite.**—Very common, large irregular grains.
**Ilmenite.**—Fairly common, usually altered to leucoxene.
**Epidote.**—Common, often angular, occasionally well-rounded.
**Actinolite.**—Rare.
**Garnet.**—Rare, pinkish-brown.
**Mica.**—Rare, probably bleached biotite.

Glass fragments.

The crop is heavy, but very poor in species, consisting mainly of iron ores.

The sandstone from Uyoma is much more fine-grained than the Asembo rock, and is evenly graded at about 1/10 mm. It is a light brown rock with thin dark grey bands and wisps in which iron ores are concentrated. The minerals...
of the lighter bands include abundant angular and sub-angular quartz, acid plagioclase, some orthoclase, rare anorthoclase, occasional grains of fibrous green amphibole, epidote and flakes of dark green mica.

**Agglomerates and tufts**—Pyroclastic types were observed in situ at the southern end of the Asembo–Uyoma road. The agglomerates are not of very coarse grade, and are soft, rather friable rocks, usually mottled by fragments or patches which have suffered chloritization or oxidation. The tufts are brownish-grey, with grade about that of a coarse sandstone or grit, with numerous small brownish and whitish fragments and occasional micaceous aggregates and shining crystals. In thin section they are found to contain fairly fresh augite, clear and altered felspars, rare quartz, rare green hornblende, rare pale brown hornblende, and occasionally fragments of basaltic rocks. The matrix contains much fine-grained opaque matter and is cut by calcite pools and stringers.

Blocks of tuff were also found about 4 miles south of Abiru. Here the tuff is a greenish-cream rock, with grade about 1/4–1/6 mm., and is cut by common irregular gashes and veinlets of mauve calcite.

**Rocks**—Lavas of two types, phonolite and nephelinite, were observed. The former occurs in small outcrops in the central part of the Tertiary belt, the latter near Uyoma Camp.

The phonolite is a dull, dark-grey rock with abundant shining dark phenocrysts up to 6–7 mm. in length, and small whitish phenocrysts. In thin section it is seen to be typically porphyritic and basaltic in texture. Augite is present as colourless or green-blotched phenocrysts, rarely well shaped and sometimes with corroded margins, and as very numerous lathy crystals (up to 1 mm. long), pale brown in colour, and feebly pleochroic. Sanidine occurs in rarer large phenocrysts. The matrix contains common small prisms of aegirine, small feldspathic prisms of orthoclase, and nepheline which occurs interstitially and in small prismatic crystals. The nepheline is, not infrequently, replaced by bright yellow cancrinite. Accessories include occasional crystals and clusters of spinel and scattered grains of magnetite, which are occasionally large (4 mm.). Small veined containing calcite and zeolites are present rarely. No hornblende or biotite is present.

The rock is a normal phonolite except in the rather high proportion of magnetite, which is unusual. It may be compared with the phonolite of Cortex (Elgon) which also contains phenocrystic pyroxene (16, p. 502).
The nephelinite is a heavy, dull dark grey rock with abundant phenocrysts of glassy nepheline and dark augite. In thin section, augite—a pale brownish-yellow, weakly pleochroic variety—is found to occur in abundant phenocrysts ranging up to 2 mm. in diameter. It is occasionally long and lathy, and sometimes slightly resorbed. Nepheline phenocrysts are somewhat less common than augite, and are, in some cases, partly replaced by cancrinite and zeolites. The matrix contains abundant small crystals of nepheline, micro-lites of basic plagioclase, small laths of augite, grains of sphene, abundant grains of magnetite, and patches of cancrinite.

This rock is generally comparable with the nephelinites of Mount Elgon (16, p. 476 et seq.), where they form the lowest members of the volcanic sequence.

5—PLEISTOCENE AND RECENT DEPOSITS

Brief mention only of these deposits is possible. Traces of gravels of the First Pluvial Period (10, p. 75) have not been recognized, though deposits formed during the Second Major Pluvial have been found in the valleys west of Bondo and in the Yala valley. In the valley crossing the Kadimo Road about 3 miles west-north-west of Bondo a section of the upper part of Pluvial II is exposed, showing the succession:

3. Clayey earth.
2. Resorted murram.
1. Red clays.

The complete Pluvial II sequence has not been seen, but Archdeacon Owen informs me that it is present at places along the River Yala near Abom.

High level gravels have been found along the Yala valley on the Bondo police track and 1 mile north of Uste T.A. The latter yielded artefacts and occasional nodules of acicular tourmaline. Examination of heavy residues failed to reveal the presence of gold or cassiterite. The minerals detected were:

- Epidote.—Very common.
- Magnetite.—Very common.
- Zircon.—Very common: colourless and pink.
- Limonite.—Common.
- Leucoxene.—Common.
Terraces, raised beaches, and gravel deposits are common along the Lake shore. A little west of Asembo Bay, a beach, 55' above present Lake level, is well exposed. Further west, a well-defined, heavily iron-impregnated gravel, 4-5 feet thick, containing abundant artefacts, caps a terrace underlain by the Miocene Sandstone, at about 40 feet above Lake level. Gravel deposits and terraces at similar levels, or lower, were also noted at various localities on the western coast. These levels are comparable with terraces in various parts of the northern Lake basin as a whole. Pebble beds at much higher levels—about 200 feet above Lake level—are reported by Archdeacon Owes to occur in northern Uyoma.

Surface ironstone deposits are found on most of the ridges of the area, but are nowhere thick. It is evident that the ironstone crust is no longer being formed, but is now suffering erosion. It varies from pisolitic and cellular types, through types which consist largely of small local rock fragments cemented by iron oxide, to the incoherent red soily decomposition products of the ironstone (tsurram). The age of these ironstone deposits and terraces at similar levels, or lower, were also noted at various localities on the western coast. These levels are comparable with terraces in various parts of the northern Lake basin as a whole. Pebble beds at much higher levels—about 200 feet above Lake level—are reported by Archdeacon Owes to occur in northern Uyoma.

There are thick deposits of black soils overlying stiff clays. At some places these have been bottomed by prospectors, who state that no gravel has been found resting on the bed-rock.

The soils of the area are of residual type and often, provide good indication of the underlying rocks. The granite margins, especially of the Asembo mass, can usually be traced by the contrast of the pinkish sandy soils overlying the granite and the heavier red or brown soils derived from the old volcanics. The basic lavas give rise to a rich red-brown clayey soil, whilst the acid lavas provide a lighter brown or greyish soil. Basic intrusions frequently yield a heavy deep chocolate coloured soil. Small scattered deposits of kunkar of doubtful age are common throughout most of the area.
Traces of prehistoric man are common in the area. Artefacts, usually of flake type, have been found at the following localities:

1. One mile west of Asembo Bay in the iron-cemented gravel.
2. In the Nvatome Valley, in ironstone, a little north of the first eastern branch valley.
3. In raised Yala gravels, 13 miles north of Usire T.S.
4. In lake gravels on the north and south shores of the peninsula south-west of Abimbo.
5. In ironstone on the flat divide east of Utonga T.S.
6. On the surface in the valley west of the Abiru granite mass.

Stone implements have also been found at many other localities by Archdeacon Owen and by various prospectors.

It is not proposed here to describe or attempt to date the artefacts found, and it will be sufficient to state that Archdeacon Owen, who has examined most of the tools collected, considers that Levalloisian, Pseudo-Stillbay and Stillbay types are present. Still later ages (? Wilton, Recent) are perhaps indicated by the remains of shell-mounds near the shores on the peninsula south-west of Abimbo.

6—THE MAJOR INTRUSIVE IGNEOUS ROCKS

The major intrusives comprise only granites and their minor modifications. They occur in a broad belt in the south, in the Abom area, and as small cupolas north-east of Gangu and at Bondo. The granites are of three types:

(a) Usually non-porphyritic; Abom, north-east of Gangu, Bondo, Tedo and Kayamo Island. (The Nyarodi type, Gs., cf. 5, p. 18 and 6, p. 31).
(b) Coarse non-porphyritic; Asembo and Ndada Islands (G of the napp). (Porphyritic or sub-porphyritic; Abiru (Gb type cf. Kisama–Mumias and Raualo Granites, 6, pp. 29–31).
(c) Porphyritic or sub-porphyritic; Abiru (Gb type cf. Kisama–Mumias and Raualo Granites, 6, pp. 29–31).

There is no evidence in the present area relative to the close dating of these intrusions. The Tedo, Kayamo and Ndada granites can only be said to be Post-Basement Complex, though on comparison with other granites which are closely similar in type, and which are intrusive into the Pre-Kavirondo Volcanic Series, they may be taken to be of Post-Volcanic
Series age. The presence of occasional granite fragments of this type in tuifs near Ngiga Mine may, however, indicate an earlier age of some of these granites.

The Abiru granite, on type, may be compared with the Gb granites of the northern No. 2 Area (6, p. 29) and is hence assumed to be of post-Kavirondo Series age. The Asembo and Ndeta granites are somewhat different, and their age will remain problematical until the investigation of the Asembo granite east of Asembo is completed. The non-porphyritic granites of type (a) are closely comparable with the Gb Nyarodi granite of the northern No. 2 Area which is considered by Dr. C. S. Hitchen to be of post-Kavirondo Series age. All the granites are alike, however, in showing little or no sign of compression or stress effects, which may indicate that they are all of post-Kavirondo Series age, since it appears that a considerable degree of folding took place after the formation of the Old Volcanic Series and again after the deposition of the sediments of the Kavirondo Series. The view that these granites are all of one age has also been expressed by Dr. K. A. Davies (2, p. 34).

(a) Granites of Nyarodi Type.

**Abom Granite.**—The granite occupies an area of about 5 square miles, with roughly oval outcrop, in the Abom area. The long axis of the intrusion extends for 3 miles in an east-north-east direction, i.e. along the strike of the Volcanic Series. The granite is only locally well-exposed, and does not give rise to prominent tors. A small tool pestle of tufts rests on the granite about one mile east of Abom T.S. From this and the frequency of quartz veins in the granite it is apparent that the cupola has been only slightly denuded. It may be suggested that even if the granite were of post-Kavirondo Series age, it is highly probable that it would not have invaded the Kavirondo Series sediments, which must have lain at a considerable distance above the granite roof.

The normal granite is somewhat variable. Typically it is a grey and dark green, mottled, medium-grained rock in which small idiomorphs of felspar can be seen, and with dark crystals of mica and hornblende, the latter occasionally in prisms ranging up to 15 mm. in length. When the Nyarodi texture is developed, the rock is seen, in thin section, to consist of abundant idiomorphs of densely sericitised, frequently zoned, oligoclase in a granitic base of quartz, slightly clouded orthoclase, micro-perthite and often some clear arionoclase.
quartz and alkali felspar sometimes grew together in crude graphic fashion, and rarely quartz and biotite are similarly intergrown. The ferromagnesian minerals are hornblende and biotite, of which one is usually partly or entirely replaced by chlorite, epidote, etc. Accessories are magnetite, apatite and sphene, the latter occasionally in large crystals or abundant in small crystal clusters. Varieties occur about 1 mile east of Abom T.S., where the granite is leucocratic and contains no biotite and at about 2 miles south by east of the T.S. where the granite had more normal granitic texture with both plagioclase and alkali felspar forming small idiomorphs and in which quartz occurs in large areas of coarse mosaic.

It is evident that the intrusion is complex. On the southwestern lobe there occurs an altered hornblende-porphryrite, in which flakes and clusters of a brown or pale green biotite of anamorphic origin, indicate that this part of the intrusion preceded the main granite. On the eastern lobe, 22 miles east of Abom T.S., another hornblende porphyrite, in which the amphibole is replaced by chlorite-calcite aggregates occurs. The porphyrite is here of later date than the main granite, of which it contains large xenoliths. North of the large dolerite intrusion, diorite-porphyrte and porphyrite are developed, but their age relation with the main granite is not apparent. The diorite-porphyrte is a hardstone, mauve-grey, (felspar-hornblende rock in which the hornblende occurs as long prisms often 7-8 mm in length. The abundant hornblende phenocrysts are set in a matrix consisting of hypidiomorphic oligoclase-andesine of fairly uniform grade, about 1 mm, with scarce small pools of quartz. Small resorbed felspar phenocrysts are rare. Accessories are magnetite and apatite, whilst chlorite and epidote are present as alteration products of the amphibole. The porphyrite is somewhat similar to the diorite-porphyrte in hand specimen, but in this slice is seen to have more frequent small felspar phenocrysts and a microgranular quartz-felspar matrix containing epidote grains, small groups of fibrous actinolite and small apatite prisms. The remaining modification of the granite is a porphyritic diorite occurring on the track 14 miles south-east of Abom T.S. It is a dark grey rock containing abundant small dark salmon-pink felspar phenocrysts. No original mafic mineral remains, and the diorite is presumed to be an earlier member of the intrusive suite.

Granite, East of Gangu.—This granite—a small cupola with clintic outcrop about 14 miles east-north-east of Gangu—might reasonably be classed as a minor intrusive, but in view...
of its affinities with the Gr granites, is considered here. The
normal granite is a medium-grained grey rock with rare felspar
phenocrysts ranging up to 10 mm. in length. The texture and
constitution are very similar to those of the normal Abon
granite. In the southern tip of the intrusion, however, it is
markedly sub-porphyritic with small altered orthoclase pheno-
cysts and common small (2 mm.) phenocrysts of variably
altered oligoclase. The matrix is fine-grained and granitic,
and contains hypidiomorphic oligoclase. The quartz occurs
sometimes in crude graphic intergrowths with felspar. Biotite,
or its alteration products, are the only mafic minerals present.

Bondo Granite.—This intrusion, forming a small cupola
around Bondo camp, is a pinkish-grey, medium-grained
granite, copiously mottled by mafic minerals. In thin slice the
dark minerals are seen to be in greater proportion than is usual
in typical Nyarodi granites. Hornblende, and, in less pro-
portion, biotite, are present, though largely replaced by
markedly pleochroic chlorite, epidote and carbonates. The
greater proportion of the felspar occurs in the typical highly
sericitised oligoclase idiomorphs, usually with clear rims.

Tedo Granite.—The granite occupies the southernmost
peninsula of the area and extends eastwards towards Uyoma,
where excellent contacts with the Basement Complex are
exposed. It is a light grey medium-grained type, speckled
by dark crystals of hornblende and biotite. In thin section the
texture is seen to be of Nyarodi type, though in patches it is
more normally eugranitic. Crude micrographic intergrowths
are usually present, and small proportions of anorthoclase
crystallize interstitially. The ferromagnesian minerals are hor-
blende and biotite in variable proportions. The biotite is
usually present in larger crystals and is commonly partly re-
placed by chlorite. Epidote occurs rarely, and magnetite,
apatite and rare sphene are present as accessories.

Kayamo Island Granite.—The granite occurs on the
south-east side of Kayamo Island, and is presumably part of
the mass which forms the Tedo peninsula. The normal
granite is a grey or creamy medium-grained rock with abund-
ant small crystals and clots of mafic minerals. Oligoclase,
variously clouded by sericite, occurs in the usual idiomorphs,
occasionally approaching phenocrystic size, and rarely in small
sub-hedral interstitial crystals. Microperthite and orthoclase,
often fairly clear, occur interstitially with quartz. Brown and
green biotite, occasionally radiately grown, is the common
ferromagnesian mineral and is usually partly replaced by
Ehretite. Hornblend, pleochroic from dull blue-green to yellow-green or grey, is less common than biotite and usually occurs in smaller, shapely or sometimes idiomorphic crystals. The crystals are often somewhat cellular and enclose apatite, feldspar, quartz and iron ore poecilitically. Accessories are magnetite, apatite, sphene and rare zircon.

Associated with the Kayamog granite are small masses of granite porphyry and microgranite, presumably of slightly later date than the main intrusion. The porphyry is a buff rock, with phenoocrysts of quartz, biotite and feldspar, the latter ranging up to 4 mm. in length and the biotites to 2 mm. diameter. The feldspars (oligoclase) have characteristically a densely clouded core and a clear outer zone in which quartz blebs commonly occur, together with occasional small crystals of biotite. The matrix consists of allotriomorphic quartz, oligoclase, orthoclase and rare anorthoclase. The orthoclase frequently encloses blebs of quartz. Apatite and magnetite are the accessories.

The microgranite is a white or pinkish-white fine-grained rock, with hand specimen, almost no trace of dark minerals. In thin section it is seen to contain quartz, orthoclase, and oligoclase associated eugranitically. The oligoclase, much less common than the alkali feldspar, tends rarely to idiomorphism. Biotite—pleochroic from deep brown to yellow-brown—is rare. Muscovite occurs in minute and small flakes and rosettes. Accessories are limonitized magnetite and pyrite.

b) Granites of Asembo Type.

Asembo Granite.—The granite extends as a broad blunt tongue from the south-east corner of the area, in a westerly direction towards Nyagoka. The intrusion is possibly sheet-like in form, deping to the south or south-west. This is indicated by the shape of the northern contact, where the margin bellies to the north on high ground, and to the south in the valleys, and by the presence of decomposed granite debris north and south of the contact. On the southern margin the contact appears to dip gently to south-west.

The granite is everywhere of coarse-grained non-porphyritic type, usually grey, but locally stained pink. The constitution varies, however, in different parts of the outcrop. The granite near Asembo Camp contains variably altered orthoclase and microperthite, smaller proportions of oligoclase, and quartz, associated in normal granite texture. The ferromagnesian mineral is biotite, pleochroic from very deep brown to
to pale golden yellow, which occurs in large thick plates, sometimes partly or entirely replaced by chlorite. Accessories are magnetite, apatite and zircons. On the old cliff south-west of Asembo Bay the granite is stained pink and shows clearly the effects of cataclasis. In this section two grades are distinguishable—coarse granular quartz, with orthoclase, microperthite and oligoclase in large irregular crystals, and a "matrix" of quartz, orthoclase, hypidiomorphic oligoclase, and interstitial microcline. Biotite and muscovite are present in small platey crystals, and magnetite is accessory. Cracks and joints are occasionally infilled by acicular black tourmaline.

This granite is well sheared on the slope behind the pier.

The granite 2 miles west of Asembo Camp is a pink and grey mottled type. It contains alkali feldspar (microperthite, orthoclase and rare microcline) and oligoclase in approximately equal proportions, the latter being rarely idiomorphic. The feldspars are often clouded by zoisite and sericite. Biotite, pleochroism from very dark green to medium yellowish-brown, occurs in rather rare, small crystals and is partly replaced by epidote and chlorite. Hornblende is now represented by a few epidote-chlorite pseudomorphs. Accessories are iron ore and apatite.

This granite is margined on the south by a thin zone of intrusion breccia in which fragments of basic tuff (a rock unknown in the basic lava series of the immediate area) and basalt are enveloped in a quartz diorite. The quartz diorite is a handsome rock with abundant crystals of hornblende (up to 5-6 mm. in length) in a pinkish felspathic matrix. In thin section the amphibole is seen to occur in irregular crystals with constituent margins, and is usually spotted by magnetite. Smaller crystals are pale green and fibrous and appear to be actinolite. Colourless augite occurs in small crystals, which sometimes edge the hornblende; much is replaced by actinolite. The feldspars are andesine in prismatic crystals, commonly assauzuritized, and interstitial orthoclase, which is sometimes graphically intergrown with quartz. Epidote and chlorite are present replacing the ferromagnesian minerals and magnetite, whilst apatite and sphene occur as accessories.

South of the quartz-diorite is a marginal belt of granodiorite containing augite, biotite and hornblende. In thin section quartz is found to be present in moderate proportion as small interstitial grains. The feldspars are largely tabular plagioclase, ranging about oligoclase-andesine, and usually
have heavily sericitized cores, though the margins are glassy-clear. Orthoclase and anorthoclase are present as small interstitial crystals. Biotite, sometimes partly replaced by chlorite, is present in many small plates, pleochroic from pale golden-brown to dark red-brown. It is often intergrown with or moulded on the other dark minerals. Green hornblende is also present, together with colourless augite, the latter being largely replaced by actinolite. Accessories are magnetite, apatite, sphene and zircon.

Owing to lack of critical outcrop it was not possible to determine the relative age of these intrusions, but on petrological grounds it appears reasonable to assume that the granodiorite was first emplaced, the quartz-diorite being produced by assimilation of the basic rocks occurring in the intrusion breccia, and that the "hornblende"-biotite granite followed later.

Locally, the Asembo Granite is heavily enriched in muscovite, notably at the north-western tip of the intrusion and a little west of Asembo Camp. At the latter locality the enrichment in muscovite occurs along cracks and joints in an area of pink staining. It seems probable that the muscovite was formed by hydrothermal action soon after consolidation of the granite.

Minor facies, including aplite granite and granite porphyry, are developed on the Asembo-Ramba road, and represent intrusions emplaced shortly after the main granite had solidified. The granite porphyry contains hornblende phenocrysts or pseudomorphs (chlorite-epidote) but no biotite, whilst the aplite granite contains no original ferromagnesian minerals and indeed almost no mafic minerals. A little south of these intrusions a small mass of quartz diorite of doubtful age is present. It is a medium-grained bluish-grey rock with abundant hornblende crystals (up to 10 mm. in length), set in a felspathic matrix. Examination under the microscope shows that quartz is present in small interstitial pools. Felspar occurs mainly in prismatic crystals ranging up to 2 mm. in length, usually very clouded but with clear margins. The hornblende occurs in large crystals, often with very curious margins, and is slightly or entirely replaced by chlorite, occasionally accompanied by epidote. Actinolite needles and fibres are also present. Biotite is much less common than hornblende, and is sometimes entirely replaced by a deep green pleochroic chlorite. Accessories are apatite, magnetite, sphene and calcite.
The Asembo granite is cut by this aplite and pegmatite dykes at several localities near Asembo.

Ndeda Island Granite.—The intrusion, which occupies most of Ndeda Island bears some resemblance to the Asembo granite. It is a coarse pink type mantled by patches of white quartz. The felspars, usually clouded by sericite, consist of epidotomorph oligoclase and large allortrophic growths of microperthite. The ferromagnetic minerals are pale yellow mica in ragged crystals and flakes, and rare crystals and aggregates of a second mica pleochroic from deep blue-green to weak brown. The yellow mica frequently edges grains and fills in cracks, and appears to be secondary. Accessories are micasite, apatite, calcite and zircon. Magnesite, often with sageritic habit, frequently occurs within the micas, and the calcite occupies small pools adjacent to them, suggesting that the original mica was destroyed and recrystallized as a hydrous form under hydrothermal conditions.

(c) Porphyritic Granites, Gb.
Abira Granite.—This granite, occurring as a large boss with oval section in the south central part of the area, is generally comparable with the younger granites of the northern part of No. 2 Area (6, p. 29). It is peculiar, however, in being in part a pyroxene granite, a type not yet found elsewhere in Central Kasongo. In hand specimens it is a grey or pinkish-grey, porphyritic or sub-porphyritic granite, and is usually fairly abundantly speckled by dark minerals. The felspar phenocrysts only rarely attain a size comparable with those of the Gb granites in areas further north.

The pyroxene-bearing facies of the granite occurs roughly centrally, in an area about one mile in diameter, extending a little north of the T.S. and for about one mile to the south. Proceeding outwards from this area, pyroxene is gradually replaced by actinolite and the portions within a mile of the margin contain only actinolite or hornblende. Near the eastern margin, intrusion breccias and hybrids are present, together with occasional small intrusions of syenite.

The granite of Abira T.S. has a rather low proportion of quartz, which is sometimes crudely intergrown with felspar. The felspars consist of stoutly prismatic crystals of oligoclase, phenocrysts of orthoclase and interstitial microperthite. The pyroxene, a pale green non-pleochoic variety, occurs in large idiomorphs and is partly replaced by blue-green hornblende or fringes of pale green actinolite. Accessories are large grains
of magnetite, large crystals of sphene and apatite. Sericite, and small pools of calcite occur as alteration products in the felspar.

The pyroxene-actinolite varieties, a little farther south, are very similar except that antiperthite appears as pheno-
crys ts, and occasionally the oligoclase is sub-pheno-
crystalline. The hornblendic granites of the marginal areas are like-
wise very similar to the pyroxene granite, except that the ferromagnesian mineral is a green or blue-green hornblende
which is often partly replaced by epidote and chlorite.

Interesting varieties of the granite occur near the road, 1 3 miles north by east of Abiru T.S. These include a graphic
hornblende granite, intrusion breccias with hybrid monzonite,
a syenite, and a granite containing hornblende, augite and
biotite.

The intrusion breccias contain abundant fragments of
basic volcanic rocks: in normal hornblende granite, which has
in patches become reconstituted to form hornblende-augite-
monzonite. The monzonite has granitic texture, but contains
only a small proportion of quartz and is much richer in ferro-
magnesian minerals than the granite. The felspars are cloudy
orthoclase and plagioclase. The augite is colourless and is
partly or entirely replaced by hornblende which is itself partly
altered to epidote. Accessories are common magnetite, sphene
and apatite, and small pools of calcite.

The syenite is a rather dark grey, medium-grained, rock,
cut by pink felspathic veinlets. The felspars consist of ortho-
clase and microperthite, usually zonally weakened, and rare
oligoclase. Quartz is uncommon, in small micrographic areas.
Brown biotite, mainly unaltered, in crystals and clusters, and
occasionally intergrown with hornblende, is common. Colour-
less or pale green pyroxene is more rare and is mainly
pseudomorphed by fibres or flaky hornblende which is a
frequent constituent. Accessories are apatite and magnetic
secondary sphene is present only where biotite is partly
altered to chlorite. It is not clear whether the syenite is a
distinct intrusion: the constitution rather suggests that it may
be a hybrid marginal facies.

The biotite-bearing granite is unusual—the normal Abiru
granites do not contain biotite. The biotite occurs in rare
small crystals, pleochroic from deep green to weak greenish-
yellow. The other ferromagnesian minerals are primary deep
green hornblende and pale green pyroxene which, in larger
crystals, is partly replaced by an amphibole indistinguishable from the primary hornblende.

Cognate "basic" clots are somewhat rare in the normal granite. They contain corroded phenocrysts of microperthite ranging up to 4 mm. in length, and granular hydrolomorphic orthoclase, microperthite and some oligoclase-andesine. Quartz is abundant as small interstitial grains. Hornblende is common in large (2 mm.) corroded crystals, small crystals, and clotted groups, frequently enclosing apatite and sphene. Greenish-brown biotite is rare. Magnetite (usually enclosed in the hornblende) apatite and sphene, are common.

7—MINOR INTRUSIVE IGNEOUS ROCKS

Minor intrusives of many types, ranging from acid to basic, are prolific in the area, and it is proposed here to give descriptions of selected rocks only.

(a) Acid and Sub-Acid Types.

The more acid types comprise the following:

Granite.—Biotite granite, about 1½ miles south-east of Gangu, and at Abimbo; mica granite near Ngiga Mill. Microgranite.—Sericitized microgranite, part of an intrusive at Ngiga Mine; biotite microgranite with thin pegmatites, ½ mile south of Anyango T.S.

Granophyre.—On the road north-west of Port Southby.

Quartz Porphyry.—Sakwa Road, near the turn-off to Poole's Camp; about ¾ mile east-south-east of Abom T.S.

Granite Porphyry.—2½ mile west of Anyango T.S.; near Bondo Police Camp; on the track 2½ mile north-west of Rambugu T.S.; part of the Ngiga Mine intrusion; on the Ngiga-Nanga road; the cupola about 3 miles east of Abiru T.S.; north flank of Unyango Hill; the lenticular cupola 1½ miles north-north-east of Utra T.S.; and north-east of Abimbo.

Granodiorite.—Near Nyagoka and ½ mile south-east of Rambugu T.S.

Tonalite.—Marginal facies of the Bondo Police Station cupola.

Acid Porphyrite.—Quartz-hornblende porphyrite near Gangu, dacite-porphyrite south of Gangu; west-south-west of Rambugu; and near the River Yala on the Bondo Police Camp road.
granular matrix of quartz and felspar associated with abundant grey rock, abundantly sprinkled with small white felspar and dark mineral. A small amount of biotite, which is sometimes bleached and often replaced by chlorite, and a fair proportion of sericitic mica are present. In its western tip the intrusion is highly sericitized, whilst on the east it contains sericite and muscovite only and no biotite. The granite near Ngiga mill is also a mica variety and contains much sericitic white mica, less frequently a bluish-green mica, and a little deep brown mica.

Microgranites.—Part of a lens-like dyke at Ngiga Mine is microgranitic and consists almost entirely of quartz and sericitized felspar. It is doubtful whether original white mica is also present. The thin microgranite vein, associated with pegmatite, near Aanyang, is also a mica type, but contains brown and green micas, whilst the felspars are fairly fresh. Small intrusive, of unknown shape, near Port Southby, is the only example of this type in the area.

Granophyre.—The small intrusion, of unknown shape, near Port Southby, is the only example of this type in the area. It is a buff rather decomposed rock, which in thin section is seen to consist mainly of quartz and altered felspar in graphic intergrowth. Chlorite is the only mafic mineral present.

Quartz Porphyries are also rare in the area. That on the Sakwa Road is a greenish-grey rock with abundant small quartz phenocrysts. In thin slice, quartz, usually about 3 mm. in diameter, is seen to be present as numerous, often resorbed, crystals. The matrix consists of coarse allotriomorphic crystals of alkali-felspar enclosing sericite, chlorite, calcite and iron ore. The dyke in the Abom granite mass is a more typical granite porphyry with phenocrysts of quartz, felspar (some of which is medium oligoclase) and calcite-chlorite pseudomorphs of biotite and hornblende, set in a fine-grained granular matrix of quartz and felspar associated with abundant sericite flakes, calcite pools and small apatites. Apatite also occurs in larger crystals and iron ore is present in scattered small, occasionally large, grains.
Granite porphyries are the commonest minor intrusives. They show considerable variation in the proportion of phenocrysts to matrix. In some, e.g., the Uanyango dyke, the phenocrysts are very abundant. Mineralogically they include biotite, bimica, sericite (Ngiga Mine and Ngiga-Nangu track), hornblende (track north of Ramnag), biotite-hornblende (Uanyango) and "augite" biotite types.

The roughly circular boss east of Abiru appears to have been originally an augite-bearing rock. Its constitution and its proximity to the Abiru mass suggest that it is the upper part of a lateral cupola rising from the Abiru mass. The rock is dark grey, fine-grained and fanned by numerous small grey felspar and glassy quartz phenocrysts. Microscope examination shows resorbed quartz phenocrysts, ranging up to 3 mm. in diameter, and cludes orthoclase and oligoclase phenocrysts ranging up to 4 mm. in length. The ferromagnesian mineral is represented by chlorite-chlorite-epidote aggregates. The matrix is a granular quartz-felspar mosaic, occasionally micrographic, and contains small irregular crystals of greenish-brown biotite, shreds of sericite, scattered epidote grains, chlorite and calcite. Accessories are apatite, ilmenite and pyrite.

Other large cupolas of granite porphyry occur at the Bondo Police Camp and 1/2 miles north-north-east of Usire T.S. They resemble the example described above except that the ferromagnesian mineral is hornblende. The remaining occurrences are small dykes. Those at and near Ngiga, for instance, are like the microgranite of the mine, characterized by abundance of sericitic mica.

Granodiorite—The dyke-like mass near Nyagoka T.S. is now a hornblende-biotite type though originally it may also have contained augite, now represented by actinolite or actinolite-chlorite-calcite pseudomorphs. It is rather similar to the granodiorite at the margin of the Asombo Granite about 1 1/2 miles east-south-east, which, however, contains a larger proportion of alkali felspar.

Tonalite occurs only on the southern margin of the Police Camp intrusion. In this section it is seen to contain a fair proportion of quartz, and abundant subhedral crystals of oligoclase-andesine, together with a low proportion of interstitial orthoclase. The mafic minerals are green hornblende, chlorite and epidote. Magnetite, apatite and sphene are present as accessories.
The intermediate minor intrusives comprise four types:—

1. **Porphyrite.**—In the Yala valley north and north-west of Bondo and at several localities on the Asembo—Abom road.

2. **Diorite-porphyrite.**—Small bosses on the River Yala 2½ miles and 4 miles east-north-east of Abom T.S.

3. **Diorite.**—At Ramba cross-roads; Bondo Police Camp track; a dyke about 2½ miles north-north-east of Bondo, and a boss 2 miles south of Serawongo T.S.

4. **Monzonite-porphyry.**—On the hill 1½ miles south-east of Rambugu T.S.

**Porphyrites.**—The porphyrites are mainly hornblende varieties, and often contain remarkably fresh hornblende. A mica-bearing type occurs ½ mile north-north-east of Asembo Camp, and a hornblende-augite type ½ mile north of the granite contact on the Asembo—Ramble road. In the field the porphyrites are grey fine-grained rocks with scattered felspar and mafic phenocrysts. Those north of Bondo are commonly stained pink. The phenocrysts are often small, but in intrusions, north of Bondo, range up to 30 mm. in length. The matrices vary considerably, and range from microgranular felspar-quartz mosaics to orthophyric types, and types containing packed hypidiomorphic oligoclase crystals associated with a small proportion of interstitial orthoclase.

**Diorite Porphyrites.**—Two small bosses of diorite-porphyrite occur in the north-east part of the area. They are rather similar to one another except that the easternmost contains no biotite and has smaller felspars in the base. The intrusion 1½ miles east-north-east of Abom Bridge is a dark brownish-grey fine-grained rock. In thin section it is found to contain abundant hornblende phenocrysts, often pseudomorphed by chlorite and calcite, and smaller rarer phenocrysts of yellow-brown biotite, which is not uncommonly grown on or near the hornblende. The matrix consists mainly of a coarse ashenhedral felt of oligoclase, together with some interstitial orthoclase. Accessories are magnetite, epidote, calcite, actinolite and abundant amphibole.

The two intrusions may be compared with the diorite-porphyrite facies of the northern lobe of the Abom granite mass, and may represent cognate intrusions.

**Diorites.**—The diorites are all quartz- and augite-bearing types, though the small boss as Ramba cross-roads also carries
biotite, and the extensive dyke north-northeast of Bondo, bio-
tite and hornblendic. That at Ramba crossroads is a pinkish-
grey graphic rock with abundant dark minerals and occasional
small "basic cloth". In thin section it is seen to be sporadically
granophytic. The feldspars, which are considerably altered,
consist of stout plagioclase prisms and some interstitial ortho-
clas. Augite occurs in colourless crystals ranging up to 2 cm.
in length, but is mainly replaced by abundant pale green horn-
blende or chlorite. Brown and green biotite, sometimes
chloritized, are also present, and rarely are intergrown
graphically with quartz. Accessories are magnetite, apatite
and spheule.

The dyke north-northeast of Bondo is a norited medium-
grained rock containing a fair proportion of quartz, which is
generally graphically intergrown with felspar. The feldspars,
which are considerably altered, consist of prismatic oligoclase
and orthoclase. Augite is rather rare and is partly replaced
by hornblende, whilst chlorite tends to replace all the ferro-
magnesian minerals. Accessories are magnetite, apatite and
pyrite.

A small mass of quartz diorite which outcrops near the
River Yala north of Bondo Police Camp, is noteworthy inso-
far as it is granitized and contains pseudo-microphenocrysts
of carbonate.

The diorite which forms the boss south of Strawongo is a
dark grey or greenish-grey rock with felted texture, and
resembles somewhat the dolerite types of this area. The
plagioclase felspar, however, is of oligoclase-andesine type,
and orthoclase is present in larger proportion than in the
dolerites, whilst the pyroxene, which is usually replaced by
scapolite or a serpentinous mineral, is idiomorphic and non-
ophitic.

**Monzonite-porphyry.**—One example only—a small mass
—was observed, on the western flank of the hill 1 3 miles south-
east of Rambahu. Biotite is common in small scattered

crystals and groups, whilst white mica occurs in flakes and
plates often intergrown with felspar. Orthoclase is present
in small tabular phenocrysts, and occurs in the matrix in
association with allotriomorphic oligoclase and quartz. Small
areas of micrographic intergrowths are present. Accessories
are magnetite, astatite, scapolite and epidote.
Epidiorites and Lamprophyres.

Dykes and small bosses of more basic type although very common in the area, comprise but few types, namely dolerites, epidiorites and lamprophyres. There is little information whereby they may be closely dated. Most are intrusive into the old volcanic series, though occasional dykes of dolerite and lamprophyre cut the granite masses. The epidiorites occur as elongated bosses and dykes in the extra-granite areas, and, on the evidence of their alteration and of the mass north of Nguda which is apparently cut off by the Abiru granite, are regarded as pre-Gb granite at least, and possibly pre-Ga granite. The dolerites, which are often comparatively fresh, are probably of much later date than the epidiorite and may be compared with other doleritic intrusions of East and Central Africa which are usually regarded as Karroo or Post-Karroo in age (4, p. 39). The lamprophyres are probably correlative with the acid and intermediate intrusives which followed the main periods of granitic intrusion.

Epidiorites and Older Dolerites.—The earlier basic intrusives occur as small dykes, and in three fairly large masses, one south of Rambupa and two in the Nguda–Abiru area. They are dense dark grey or green-grey rocks, with closely felted texture, and sometimes contain small "phenocrysts" of a hornblende-like mineral. In thin sizes it is often possible to trace textures which suggest derivation from quartz dolerites, though occasionally original textures are completely destroyed. At Nguda, the constitution varies from doleritic to epidioritic in different parts of the intrusion. Elsewhere relics of augite sometimes remain, but are rare.

The dyke 11 miles east-south-east of Rambupa may be quoted as a typical epidiorite. In this section, it is porphyroblastic with large feldspar and semi-compact growths of actinolite, which also occurs as needles and fibres in the host. Chlorite is present in irregular pools of variable size, and epidote occurs in granular clusters. Quartz is present in granular pools, whilst glass-clear recrystallised feldspar constitutes the remainder of the base. Pyrite and ragged skeletal grains of magnetite are the accessories.

Older dolerites, not epidioritized, occur at Chausu Mine and Lamata Mine in western Sikwa. Both are of earlier date than the quartz veining, and are of sub-porphyritic ("augite") ophitic type. They are distinguished from all other altered dolerites of the area by lack of actinolite. The felspars are completely recrystallised and in the Chausu intrusion the augite
An actinolite greenstone, part of a mass of epidiorite and altered dolerite north of Usire, which may belong to this group, is characterized by the presence of large plagioclase and stellite aggregates of actinolite. It is comparable with a pre-granite greenstone noted in the No. 1 Area (17, p. 24).

Lamprophyres.—The dykes and small masses of this class are few in number and comprise:

1. *Augite vogesite.*—In granite 2+ miles south-east of Abom T.S.
2. *Augite-hornblendite spessartite.*—West flank of the hill 3½ miles south-east of Rambugu T.S. and on the track 2½ miles east by south of Gangu.
3. *Hornblendite spessartite.*—In the Utonga Valley 3 miles east-south-east of Utonga T.S.
4. *Quartz-augite spessartite.*—21 miles east-north-east of Abim T.S.
5. *Augite-hornblendite comitrite.*—East flank of the hill 1½ miles south-east of Fainzbugu T.S.

All are rather dark grey fine-grained rocks, some with small pink or glassy felspars, and usually contain numerous small crystals of dark ferromagnesian minerals. The spessartite (3) southeast of Rambugu may be described as an example. Idiomorphic augite, sometimes partly replaced by fibrous brown amphibole, is common in crystals ranging up to 1½ mm. diameter, whilst light brown hornblende crystals are also abundant. Actinolite and chlorite occur in large vesicle-like pools and interstitially to the felspars. The matrix is a fibrous matte of coarse laths of medium oligoclase, often sericitized and associated with interstitial orthoclase. Accessories are iron ore and sphene, the latter possibly secondary.

Dolerites.—Dolerites are very frequent in the area, usually as small narrow dykes, but occasionally as large dyke-like sheets (e.g. near Abom). They are evidently more common than is shown on the map for some blocks and so derived from dyke-like rocks are often seen where no outcrop occurs. Normally the outcrops are of short extent, strikes being frequently about northeast or south-east, though strikes about east-west and north-south also occur. The rocks are usually dark grey or greenish-grey, with felted texture, and sometimes contain abundant dark phenoocrysts of augite, ranging up to 5-6 mm. in diameter. Black fine-grained basaltic
Microscope examination indicates that the following types are present:

(1) Quartz dolerites; very common and comprising the following varieties:
   (a) Ophitic.
   (b) Ophitic, containing brown biotite; not common, mainly in the eastern part of the area and south-east of Nguda.
   (c) Poecilophitic, e.g. in the peninsula south-east of Abimbo and near Chausu.
   (d) With porphyritic non-ophitic augite and a second generation of intergranular augite; rare, e.g. the dyke near Bellamira Mine.
   (e) With intergranular augite only.
   (f) With felspar phenocrysts; rare, e.g. the dyke 1½ miles south-south-east of Abom T.S.

(2) Quartz dolerites with a rather high proportion of interstitial orthoclase.

(3) Granophyre-dolerite; one example only, near Kadimo.

These types cannot be described here in detail, but the following points may be noted:

1. The degree of alteration varies considerably—some are almost quite fresh, others are slightly or much altered, though, in most cases the texture is not entirely destroyed and relics of augite remain. The felspars are clear or variously clouded by sericite, zoisite and epidote, whilst the augite is variously replaced, entirely or in part, by actinolite, chlorite, epidote and serpentinous minerals, and occasionally by a brown hornblende.

2. They usually contain some granophytic mesostasis.

3. Many are characterized by the presence of large skeletal intergrowths of magnetite and leucoxenized ilmenite.

4. No quartz-free dolerites have been observed.

5. None of the types carry olivine.

The granophyre dolerite of Kadimo is an unusual type with sub-porphyritic, slightly ophitic, augite and is characterized by an abundance of large areas of micrographic intergrowth of quartz and felspar.
The metamorphic history of the area is naturally somewhat complex, though, as usual in Central Kavirondo, the degree of metamorphism attained at any one period is not considerable. The regional metamorphism exhibited by the Basement Complex gneisses and granulites is of comparatively low grade, whilst regional metamorphism of the old volcanics is slight and mainly of retrograde type. Thermal metamorphism by the larger intrusives is also slight and is restricted mainly to the patchy development of biotite in the lavas and tufts usually within a short distance of igneous contacts. The development of biotite in lavas and tufts about 1 mile west of the western Abiru contact may be taken to indicate that, though the granite contact appears to dive steeply at the exposed margin, it slacks considerably in depth.

The minor degree of metamorphism effected by the larger intrusives is well illustrated by the slight alteration of xenoliths. Near Asembo Bay small blocks of basic lavas engulfed in the granite are found to consist largely of chlorite and sericite in a base of recrystallized felspar, with occasional pools of quartz and abundant small disseminated grains of iron ore. Blocks of basic stuff enclosed in the marginal granite two miles further west, also show no sign of anamorphism.

The metamorphic effects of the Abom Granite are similarly slight, as is shown by the lack of anamorphic minerals in the tufts of the roof-pendant which rests on the granite about one mile south by east of Abom T. S.

The most interesting metamorphic effect has been produced in the basic lavas close to the granite margin about 1½ miles west-south-west of Asembo Camp, where large irregular aggregates of quartz, epidote, clinozoisite and a whitish garnet, cut by calcite-filled gashes, have been formed. The garnet has idiomorphic outline against the quartz. Similar effects have not been noted elsewhere.

VI—TECTONICS

Folding—At the present stage of knowledge of the area the nature of the folding cannot be dogmatically described, especially as it is evident that folding has occurred at several periods, namely, post-Basement Complex, post-old volcanic series, and, in a minor degree, post-quartz-veining. The folding which followed the formation of the Pre-Kavirondo Volcanic Series is indicated by the distribution of the volcanic suites. It thus appears that, from north to south, there are a
series of folds with approximately west-south-west strike, and pitching to east-northeast, viz.:—

Syncline.—Along the Yala valley and through Usire. *Articline.*—Along the higher slopes of the Yala divide, north of Bondo and westwards towards Utonga.

Syncline.—Bambio to Bondo and westwards to Sfu Island. *Articline.*—Gangu to Senwongo.

Syncline.—Central Asembo to eastern Abimbo. *Articline.*—The area between Abimbo and Tebo.

Syncline.—Tedo area.

The diagrammatic section given in Figure 2 indicates the nature of the folding. The shape of the folds is not definitely known, though the rare occurrence of steep apparent dips and comparison with the northern part of No. 2 Area (15, p. 82, and 1, p. 15) may indicate that the limbs are steep, possibly vertical.

Folding of later date than the incidence of quartz-veining is seen only in waterworn excavations and is described in a later section (p. 62).

Faulting.—On the flat divides there is no trace of faulting, and it is only on some of the rather complex hill groups—Usire, Abom, Ngafo and Abisa—that faulting is suggested by the deformation of the surfaces. No definite evidence of faulting has been obtained, however, and faults are accordingly not shown on the map, though the sketch form lines on the hills mentioned will indicate where it is suspected that faulting occurs.

It is possible that a major fault of late date runs along the shore of the Kavirondo Gulf. The only evidence is the sheering of the granite at Asembo pit and the crumpling of Miocene limestone in Gyoma (south of the present map). The postulated fault may be the western branch continuation of the Nyando and Sena faults. (14, front plate, and 1, p. 10)

Small faults are not infrequent in mines and excavations, notably at Ngiga (p. 60) and Chausu (p. 62), but the information is too scanty to give any conception of the fault patterns and isoclines of the area.

Shearing.—Widespread cleavage has not been imposed upon the rocks of any part of the area, though local shearing is occasionally seen. In some cases quartz veins have been emplaced along shears or crush zones. The more notable of these are the crush zones running approximately north-south at Bellamure Mine, and through Nangu T.S. Where a series of veins occurs in an extensive crush zone,

...
FIG. 2
North-south section of the Sikwa area, passing approximately through Bondo and Odiero Hill.
3. Basic lava suite.
2a. Agglomerate.
2b. Tuff.
1. Andesitic suite.
R. Rhyolite.
D. Diorite Dyke.
P. Porphyrite.
**VII—ECONOMICS AND MINERAL RESOURCES**

During the present investigation valuable minerals other than gold, have not been found in commercial quantities. Copper staining was observed in the peninsula south-west of Asirbo, and has been reported elsewhere, but it is apparently of academic interest only, the copper carbonates being derived from disseminated chalcopirite which occurs sporadically in the old lavas. Galena is present in small quantities in some of the gold-quartz veins, but again has no commercial significance.

Gold has been found in many parts of the area and is being worked by a number of large and small syndicates. The localities at which gold deposits were being developed or exploited during the survey are shown on Figure 3. The area has proved to be the more auriferous part of the No. 2 Area. It is recorded that, since it was opened to prospectors in May, 1934, more than 20,000 ounces of gold have been produced.

1—**GEOLOGY OF THE GOLD DEPOSITS**

All the gold deposits of the area consist of quartz veins or nodule derived from the disintegration of quartz veins. The quartz of the veins is usually of massive white type, ranging from glassy to sugary in texture. Blue quartz, however, does occur and is sometimes confined to one portion of a vein, though veins composed entirely of blue quartz are uncommon. In some cases the vein quartz is laminated. Sulphides are usually present, consisting of pyrite, chalcopyrite, galena, and —in the case of veins associated with the Abom granite—mispickel. Pyrrhotite is also said to occur in some of the veins.

Examination under the microscope shows that most of the veins are composed of irregular mosaics of quartz, which consist of fine-grained and coarse-grained areas arranged with no apparent order. Occasionally the mosaic is mainly fine-grained, e.g. in the Chausu Main Vein.

The quartz is usually heavily speckled by minute inclusions though these increase in the finer grained portions whilst the coarse grains are edged by thin zones of clear quartz. The whole slice is frequently cut by abundant anastomosing "veinlets" of clear quartz which, however, do not appear to be true veinlets of later date than the main mass of the quartz. In rare cases, notably the laminated quartz of the footwall portion
of the Fabal Reef (south-west of Abom) the coarser grained quartz shows a strong tendency to elongation of its grains parallel to the strike of the veins. In all cases examined, with the notable exception of the Ngiga Vein, calcite or sericite, or both minerals, occur grown among, or rarely, enclosed in, the quartz grains. In exceptional cases, e.g. the Bellamira Sybil Reef, the carbonate can be proved to be of later date than the quartz vein. Felspars were observed only in a small portion of the Sybil Reef.

The size and disposition of the veins is very variable. Thicknesses vary from a fraction of an inch to about 10 feet, and the veins are usually characterized by constant swelling and pinching. The average thickness of the workable veins probably lies between 15 to 24 inches. The strike extent ranges from about 100 feet to a maximum of about 1,500 feet. The Quinyala Reef, which enters the area a little north-east of Ramba cross-roads, is said to have a total strike of over 2 miles, but it is to be suspected that several distinct veins occur within a zone extending over that distance. Dips are usually slack, so that in many cases veins have been developed by inclined adits. A notable exception is the Midas main vein near Ramba, which is almost vertical.

The distribution of gold in the veins is in some cases sporadic, but in others, notably at Midas Mine, Barkowino, Coronation Mine and Lamac Mine, appears to be concentrated in shoots. In all cases, however, it seems that the gold is largely confined to the main vein structure in any one vein system. Moreover, values are not in general found in the wall-rocks of the veins, though at a few of the mines, low-grade wall impregnations have been noted.

Examination of Figure 3 will show that the greater number of the mines occur in restricted areas, in close proximity to the major acid or sub-acid intrusives, extending from the Abom granite in the north-east, south through the diorite at Ramba crossroads to the Asembo granite, and then roughly south-west along the line of the Asembo, Abiru and Tabo granites. In that section of the area lying north-west of a line from Abom T.S. through Bomba to Sifu Island—where major intrusives do not occur at surface—there is a marked lack of valuable or sizable veins.

The disposition of the veins towards the granites varies somewhat. The Abom granite is characterized by numerous relatively small veins which occur within the granite outcrop and frequently strike more or less parallel to the long axis of
the intrusion, i.e. about east-north-east. There are comparatively few veins outside the granite mass, notably the Fabal, Janabo and Sheri, and perhaps the Goniola reefs, which also strike approximately parallel to the long axis of the granite. The last-named veins occur south-east of the granite, and dip rather steeply to the south-east, but the Fabal Reef, which is almost on the prolongation of the granite axis dips to the north-west. The tenor of the evidence suggests that the Abom granite is a very slightly denuded cupola, and probably, that the lateral extra-granite veins were intruded during a period of collapse or recession of the granite magma.

The Midak vein is unusual, insofar as it is not close to any major intrusions; it may, however, be connected with the smaller quartz carbonatite mass at Rambo cross-roads, which may indicate a hidden granite cupola.

Proceeding westwards, the next marked area in which auriferous veins occur is the Gangu-Waringo district situated between the western tip of the Asemba granite and the smaller granite masses at Bordo and that east of Elijah. The strikes of the veins in this area are variable, though there is a tendency to group about north-east to north-north-east. Where such strikes obtain the dips are always to the north-west or west-north-west.

Veins apparently connected with the Abiru intrusion are most abundant in a two mile wide belt which adjoins the granite margin on the west. The veins exhibit a marked radial trend with respect to the granite (Fig. 4), strikes varying from north-west to north in the northern end of the granite. For veins of workable size or value have been found north and north-east of the granite.

The veins of western Sakwa—around Bellamira, Ngiga, Lamac and Chausu—cannot readily be connected with the Abiru granite, though the comparative nearness of an under-ground extension of the granite may be indicated by the acid and intermediate intrusions at Ngiga, Bellamira and on the Port Settoby road. The veins of the Chausu area are, however, far from known intrusives of this type, and their origin is doubtful. In an area of about 24 miles radius around Nangu T.S., most of the veins strike between north-west and north. This is especially marked in the vein system running from Kungwe Hill to north-north-west of Nango T.S. Exceptions, with east-north-east or north-east strike, are rare. Dips are generally slack, especially at Lamac Mine (5°—20°), and usually incline to the west or south-west. A notable exception to this is
the Nangu Mine vein which dips to east-north-east. The general conformation of the veins in this area suggests that they may be connected genetically with a subterranean crease of the Abiru granite running in a north-westerly direction.

The several veins discovered in the Chausu district strike commonly between west-north-west and north-north-west, and may also be connected with the hypothetical extension of the Abiru Granite.

It thus appears that the majority of the veins of the Asembo-Sakwa area are connected with the Aborus, western Asembo and Abiru granites. Mineralization accompanying the eastern Asembo, Tedo, Kayamo and Ndeda granites appears to have been negligible.

2.—DESCRIPTIONS OF GOLD OCCURRENCES

In this section descriptions are given of the various properties which were being worked or developed during the course of the survey. The order of description is from east to west and the number of each description corresponds with the numbers of Fig. 3.


   The mine is situated about 4 mile east of the cross-roads at Ramba. The country rock near the mine is entirely composed of altered basalts, though a small boss of diorite occurs at the cross-roads. Four principal veins have been discovered on the property of which the most southerly is a gash vein with an approximately north-south strike (Fig. 5a).

[Sketch Diagram showing the positions of the quartz veins on properties in the Asembo-Sakwa area. Veins shown by heavy black lines. Scale: 1 inch = 1 mile. Sides of diagrams oriented north and south.

(a) Midas Mine (Messrs. Yates & Whithamsh).

(b) Johnson Stamps Syndicate—holdings east of the Ramba-Abos Road.]
The more westerly of the two northern veins has a strike extent of about 600 feet and runs more or less parallel to the main central vein. The latter has been traced discontinuously over a strike of about 3,000 feet, but only the western 1,500 feet have been followed underground (to a depth of 115 feet). The western portion of the main vein strikes at 55° and the eastern portion at 45°. The western part is almost vertical and is usually a persistent, solid vein varying in thickness from 3–4 feet, occasionally swelling to 10 feet, and occasionally splitting and branching in shear zones. The quartz is a white glassy variety with sporadic pyrite and inclusions of chloritic material, while shattering and marked infillings of gouge are not infrequent. It appears possible that the main vein may be folded and that the change in strike of the main vein and of the two northerly veins may be due to a fault running across the property in a north-westerly direction.

In the main vein, gold is apparently confined to shoots pitching at 35° to 40° to the west, though values are also found occasionally in 2 to 4 inches of the hanging wall. Visible gold is rare and is said to occur only where the quartz is severely crushed or heavily impregnated with iron oxides.

Mining was carried out between January and August, 1935, and recommenced in June, 1937, the production to the end of 1937 being approximately 842 ounces of gold and 116 ounces of silver.

2. Pakaneusi Prospecting and Development Co., Ltd. (Government Reef).

The western extremity of the large white quartz vein extends into the present area at the Native School, about a mile south-east of Ramba cross-roads. The strike is approximately east-north-east (12, p. 31 and 13, p. 9).

Mining operations have been confined to the eastern section of this vein which lies beyond the eastern boundary of the present map.

3. Quinyla Syndicate.

The western extensions of the large vein system so far explored occur in the area lying immediately north-north-east and north-north-west of Ramba cross-roads. The white quartz veins strike about east-north-east in the eastern section of the system but veer towards north-east near the Ramba–Abom road. Dips range about 60° to the south-east (13, p. 9).

The Syndicate has held many properties in the area, mainly in the Abom district (Fig. 5b). Properties lying to the east of the Ramba-Abom road comprise:

1) The Beatrice Reef, which consists of small veins emplaced in the granite at its contact with the volcanic series, about 2 miles east by north of Abom T.S. The veins were followed to a depth of about 40 feet, but gold values were found mainly near the surface and in rubble.

2) The Happy Day Reef which is located about 2 miles east by south of Abom T.S. and consists of a lens of white quartz with a strike of 60°, extending over about 100 feet, in granite. Rich values were obtained down to a depth of 60 feet where the vein became very narrow.

3) The Jambo Reef which is situated about 3 miles east of Abom T.S. and consists of a complex of veins, striking at about 70° and extending over about 200 feet. The dip of the main vein is about 70° to the south-southeast. It ranges up to 48 inches in thickness east of the shaft. Good gold values were encountered near the surface but decreased with depth in the 60-foot shaft. The country rock—members of the andesite suite of lavas—also contained values.

5. Johnson Starnes Syndicate (Fabal Reef).

The most important holding of the Syndicate is the Fabal Reef, situated about 2 miles west-southwest of Abom T.S., in an area of altered andesite lavas. The vein strikes at about 50° and extends over a length of about 1,100 feet, with a dip of 55° to 60° to the north-west. The vein, which has been exposed to over 200 feet in depth, lenses continuously and has an average thickness of about 30 inches. It is in part composite, with a footwall 'leaf' usually constituting...
about a quarter of the total width—of white or greyish-white, glassy or dull, laminated quartz, which is frequently heavily pyritized and carries free gold. The more persistent hanging-wall leaf of the vein is a dense white or bluish white quartz, sometimes heavily intergrown with pyrite. It is believed by some investigators that the lower leaf is of later date than the upper, this notion being seemingly supported by the fact that in places the two portions of the reef are separated by one to four feet of the country rock. Gold values are highest in the south-western part of the mine, and are mainly restricted to the footwall section of the vein. The hanging wall portion carries values but of relatively low grade, except where the footwall leaf is absent or where the hanging wall portion carries good values. Small faults cut the vein obliquely but are apparently of little significance. There appears to be no shearing.

Mining was commenced in August, 1935, and up to July, 1937, when production ceased temporarily, about 3,175 ounces of gold had been produced from the various properties worked by the Johnson & Starnes Syndicate.


The Syndicate operates on claims in the Abom area, the main property being about 2 miles south-east by south of Abom T.S., within the Abom granite. The white quartz vein now being worked strikes at about 70° and is about 12 inches thick at the surface, but thin downwards. Valuable rubble has also been worked. A little west of this vein a second white quartz vein, 12-20 inches thick and striking at 102° over about 200 feet, has also been investigated. Other veins, a little south of the granite margin, are being explored. The gold produced by this Syndicate, between September, 1936, and November, 1937, was approximately 412 ounces.

7. Golden Bend Syndicate.

The Syndicate was originally formed to work alluvial deposits in the Yala River near Abom, but later worked in the footwall section of Abom Hill. Small and impersistent veins, lying within the granite and often very rich, were worked and were followed to a maximum depth of 50 feet. Work ceased in October, 1937, after a total of about 670 ounces of gold had been recovered since milling commenced in May, 1935.

8. Bell Bird Syndicate.

Operates a small property about 2½ miles west-south-west of Rambu cross-roads. The main vein, a massive grey-white or white type, strikes approximately due north and dips 54°
the west, and has a maximum thickness of about six feet.

There is a considerable tonnage of collapsed reef.


The workings are situated on several blocks of claims

on the flat divide about two miles south-south-east and south-

east of Bondo Camp. The country is here composed of mem-

bers of the andesite suite of the volcanic series, cut by small

basic intrusions.

Several veins and vein systems have been discovered

(Fig. 6a) and some of them have been worked. The northern

vein (near the camp), lying in a shear zone, strikes at about

32° over approximately 600 feet and dips to the north-west

at 60°. Its thickness varies from 8 to 42 inches. In its

southern portion, the vein consists of white granular quartz,

but on tracing northwards, it grades through white and blue

quartz to dense blue quartz with little sign of mineralization

at the northern end. Gold values are said to lie in shoots

pitching at about 45° to the south-west. The vein has been
developed by small opencasts and by shafts to the 100-foot

level.

The southern vein, which occurs about one mile south-

south-west of the camp is sometimes heavily pyritized. It

strikes at about 22° over approximately 1,800 feet, and dips to west-north-west

at about 75°. The vein, implaced in a marked shear zone,
lenses, and possesses a maximum width of between 50 and 60

inches. Gold values are said to be greater where the vein is

thicker. The vein has been developed by inclined shafts and

small opencasts.

Other veins include—

(1) one, slightly off the strike of, and a little to the north

of the camp veins, which is composed of white quartz

and dips steeply to the north-west. The values are

stated to be low;

(2) a white quartz vein, occurring about 100 feet east of

the camp vein, which strikes north-east. At the

northern end the dip is 60° to the north-west, but

the vein becomes more steeply inclined towards its

southern end. The thickness of this vein varies from

12 to 15 inches;

(3) a group of veins, displaying strikes similar to those

of the main veins, which occur about midway be-

tween the north vein and the south vein. A further

vein, with north-west strike, occurs a little to the

east of the group.
Between December, 1936, and December, 1937, about 637 ounces of fine gold were produced from the property, whilst earlier in 1936 some 90 ounces had been produced by the previous owner.

10. Lantara, Ltd. (Benzo Mine).

This prospect is in the early stages of development and is located on claims formerly held by the Kenya Uganda Minerals Exploration Co., Ltd., about 3 miles south of Gangu T.S. The vein now under examination strikes about south—east in its southern part but turns to approximately east—west in its northern section. The total strike is about 1,000 feet, though the vein has not yet been proved in the central portion. In the south it is a white granular quartz vein the dip of which varies from 60° to 85°. The thickness is from 4 to 22 inches and is said to increase towards the bottom of the 50-foot incline. The northern section of the vein, 6—18 inches in thickness, is sporadically pyritic and contains rich pockets of ore. The quartz in both sections of the vein tends to be laminated.


The property is situated in the broad shallow valley about 3 miles south-west of Gangu T.S. Development was not far advanced at the time of the writer's visit, being confined to trenching and to an inclined adit. A complex of white quartz veins, extending over a width of 96 inches has been exposed near the surface. This complex thins to a vein about 10 inches wide at 80 feet on the incline, but widens to 12 inches at 90 feet. The strike is 150° over about 90 feet, and the dip 35° to the south-west. Gold values are mainly confined to the wall portions of the vein complex. A little to the east of the vein complex, there appears to be two distinct veins, one of which turns to the south and has been traced over 600 feet. Its gold content is stated to average about half an ounce per ton.

Milling was commenced at the end of October, 1937, and by the end of January, 1938, about 63 ounces of gold had been obtained from 40 tons of ore.


This Syndicate has operated on various blocks of claims in western Asenaho and eastern Sakwa. The most important occurrence is the Good Luck Reef, about two miles south—south-east of Gangu which has been opened up by a large open-cast and by vertical shafts. The vein strikes approximately north—south over about 125 feet and dips at 60° or more to the west. It is composite, with a hanging-wall portion.
of white glassy quartz and a thinner footwall portion of white or bluish-white, often laminated. Quartz, which is frequently heavily impregnated with iron oxides. The vein, as a whole, lenses somewhat, and the footwall leaf tends to be independent. At the surface the vein had a maximum width of 60 inches and was accompanied by lateral veinlets some of which carried very high gold values. Underneath, on the 90-foot level, the maximum thickness is 96 inches, while the average lies between 24 and 30 inches. Below the 90-foot level the vein appears to thin downwards. Locally, the vein splits and bivinch veinlets occur. Gold values are normally restricted to the footwall leaf of the vein and appear to occur in a shoot with a steep pitch to the north. The country rock consists of altered basic lavas cut by small basic intrusions, and carries values near the vein.

The milling of ore from this vein was commenced in August, 1936, and about 1,680 ounces of gold had been produced to the end of 1937.

Various other veins have been discovered near the Good Luck Reef. These are of white or bluish-white quartz and strike about north-south or east-west. In addition, veins have been uncovered and worked by shafts and opencasts in the area between Gangu and the Good Luck Reef. One of these, located about 1½ miles south-south-east of Gangu, strikes east-west and dips at 57° to the north, and has been followed to 95 feet inclined depth.

13. R. Simpson’s Prospects.

Two adjacent massive white quartz veins, 20-30 feet apart, were discovered in the area north of Abiru Hill. One is about 36 inches wide and dips at 45° to the south-west. It has been opened up for about 100 feet along the strike. The second vein is also about 36 inches wide, dips at 30° to the south-west, and has been opened up for about 50 feet. There is a considerable amount of collapsed reef.

14. J. R. Poole’s Prospect.

The prospect is situated on the flat-topped divide about 2½ miles north of Abiru T.S. Two veins have been opened up by trenches, pits and opencasts. The southern vein is complex and has an apparent strike of 125° and dips at 18° to the south-south-west. It consists of white quartz with sporadic pyrite and in one trench it is 12-18 inches thick; in others, however, it splits to form several veins extending over a total width of 84 inches. It is possible that this vein is actually dome-shaped.
The northern vein strikes at 195° and dips at 35° to the west. The quartz is a white sugary variety, which often displays a tendency to lamination. East of the vein there is a considerable extent of collapsed reef from which rich rubble has been obtained. Both veins are emplaced in andesite cut by a dolerite dyke a little to the east of the outcrops of the veins.

Milling was commenced in December, 1937, the ore being carried to the head of the bay at Abimbo.

15. W. Hildred's Prospect (Nguda).

Properties formerly held by N. B. van Deventer and by Kenya Development, Ltd., under option, are worked. The main occurrence is about 3/4 miles south-south-west of Abiru T.S., in the south-eastern edge of the epidiorite-dolerite intrusion of Nguda. Here, two parallel veins, 80 feet apart, have been opened up over about 250 feet, and are now being explored underground. The strike is approximately 65°, and the dip almost vertical. The northern vein is 6 to 12 inches thick with lateral branches, and the southern averages not less than 12 inches. Values are confined to the quartz veins which are of a bluish-white type. Milling was commenced in March, 1937, and by the end of that year about 5% ounces of gold of average fineness .865 had been produced from 1,327 tons of ore. The previous owners had already extracted some 800 ounces of gold from the property. Other veins south-west of the main occurrence are also being investigated.

FIG. 6a AND b

Sketch diagrams showing the positions of the quartz veins on properties in the Asembo-Sakwa area. Veins shown by heavy black lines. Scale: 1 inch = 1 mile. Sides of diagrams oriented north and south.

(a) Coronation Mines, Ltd.
(b) Bellamira Development and Mining Co., Ltd.
ranging up to 15 feet in depth.

The country, which here consists of dacites, andesites and agglomerates cut by occasional porphyrite and dolerite intrusions, is very poorly exposed and is usually covered by murram, ranging up to 15 feet in depth.

Two veins, the Sybil and the Home Reef, have been developed by inclined shafts, the former to a depth of 660 feet in one shaft and the latter to about 155 feet. The Home Reef, consisting of a white quartz vein ranging from 2 to 20 inches in width, strikes at 23° to the south-west. The Sybil Reef, extending over about 1,100 feet, strikes approximately north-south but curves to the west at its extremities. In the upper levels the dip is about 20°—30° to the west, but increases to 45° in the main shaft near the fourth level. The reef comprises quartz gashes and stringers in a crush zone. Near the main shaft, the zone tapers to a width of 84 inches and contains two or three "horizons" of quartz in lenses ranging up to 36 inches in thickness. The quartz is a dull white, greyish-white or pinkish-white variety carrying a small amount of pyrite and, occasionally, galena. In thin section it is seen to be composed of variously coarse and fine quartz mosaic with stringers, patches and individual crystals of calcite. Cloudy felspar is associated with the quartz in some parts of the mine. Gold values are mainly confined to the quartz masses and in the gouge adjoining them in the crush zones, although the remainder of the crush zones and the wall rocks, where silicified, also carry values. Marked enrichment occurs above water-level. Faulting and shearing is of minor occurrence only.

Milling commenced in March, 1936, and at the end of 1937, more than 4,000 ounces of gold had been produced. Recently, a new vein, having a strike of about north-west and a dip of 22° to the north-east was discovered about 1 mile south-south-east of the main shaft of the Sybil Reef. The quartz resembles that of the main reef.

Other properties examined by the Company include:

(i) Messrs. Brown and Barratt's Claims in the Abimbo area. Many veins are known, one of which, located near the granite lens east of the bay, was worked during 1934-5. This is composed of greyish-white quartz which occurs as stringers and lenses in a shear zone. The
traced underground. The dip is variable—usually about 20°—
the bay west of Abimbo, and about one mile from the Lake
glomerates which are invaded by a dyke-like lens of muscovite
east-west strike and a maximum width of 150 feet. The
granite porphyry and microgranite. The lens has an almost
shore. The country rock comprises andesites, tufts and ag-
vein cuts both the volcanics and the intrusive. It extends over
a distance of at least 900 feet and has a strike ranging pro-
gressively from northwest in the western part of the mine to
west-south-west in the eastern part. Minor rolls have been
traced underground. The dip is variable—usually about 20°-
30° to the westerly or southerly directions.

The vein consists of white, greyish-white or bluish-white,
massive, glassy or sub-glassy quartz, carrying sporadic pyrite
and occasional galena. The vein is of variable width, ranging
from a fraction of an inch up to 50 inches, but averages
between 15 and 18 inches. It is usually accompanied by a
thin gouge or shear on the footwall and pinches and swells
continuously, although it is rarely completely pinched out.
Even when this is the case, the “fracture” is marked by a narrow
shear.

The vein has been developed by inclines and by vertical
shafts sunk to a depth equivalent to 300 feet in the incline.
At or near the first level (80 feet vertical depth), a tear-fault
with a well-marked shear zone from 2 to 20 feet in width
intersects the vein. This fault strikes parallel to the vein in
the central part of the mine, but turns away from the vein near
the latter’s north-western and south-eastern extremities. The
fracture fluctuates about 5° to the north-east or south-west, whilst
the throw to the south-west increases progressively from 5 to
6 feet in the north-west to 40 feet or more in the south-east.
Small faults and shears also occur in other parts of the mine.
Gold values occur throughout the vein, being poorer where
the vein cuts the granite porphyry, whilst notably high values
have been encountered in the south-eastern part of the mine.
January, 1938, about 1,105 ounces of gold had been recovered from 2,035 tons of ore. Previously, some 527 ounces had been obtained by the Njoro-Soy Mining Company—the former owners.

Nangu Mine.

During the earlier part of the survey this mine was being developed by Messrs. East African Goldfields, Ltd., but was closed down in December, 1936, and has not yet been reopened. The mine, which is situated a little to the south of Nang’i T.S., operates on the Kinon Reef—a series of quartz veins and gashes in a heavily pyritized crush zone which is stated to carry workable values over a width of 25–30 feet. The wall rocks are frequently suffused and pyritized while the occasional development of needles of arsenopyrite, both in the quartz and country, is usually indicative of good gold values.

The reef strikes at about 157° and dips to the east-north-east.

A mineralized belt, characterized by a number of individual quartz veins and silicification of the country rock extends across the property in a north-north-westerly direction, and has been traced for a distance exceeding 3,000 yards.

Asembo Mines, Ltd. (Lamac Mine).

The mine is situated on gently sloping ground about one mile south-east of Serawongo T.S. There are at least two large veins on the property. That being worked at present strikes about 103° over more than 600 feet. A second vein, a little to the north-west of the first, strikes about south by west and dips gently in a westerly direction.

The first vein has been developed by inclines and round pits, whilst a shaft sunk 500 feet west of the outcrop intersected the vein at a vertical depth of 106 feet. The vein is composed of a coarse-grained white, greyish-white or bluish-white, occasionally blue, marly quartz and contains scattered chlino-talcic spots and, very rarely, pyrite crystals. The width of the vein varies from a fraction of an inch up to 48 inches and averages about 15 inches. Where the vein has pinched out a "fracture" or leader of more decomposed country rock is present: shearing is rare. The dip is variable, usually 5°–10° to south by west, but in places is as steep as 22°, whilst side-rolls, reversals and flattening-out occur occasionally. In places the vein splits, though normally it is a single vein. Gold values
are stated to be greatest when the vein is thinner and free from iron-staining, and appear to be confined to shoots. The country rock consists mainly of decomposed acid lavas, but in the area of the main shaft there is an intrusion of altered dolerite. The wall rocks of the vein barely carry values.

Milling was commenced at Port Southby in August, 1937, and approximately 105 ounces of bullion had been produced by the end of the year.


The mine is situated near the Lake in the most westerly part of the area. The country rock here consists mainly of acid lavas but in the mine an intrusion of altered dolerite has been encountered.

The principal vein now being developed strikes at 124° over a distance of about 1,000 feet. The south-westly dip is about 30°—32°, but in places varies considerably ranging from 10°—70°. The vein, which is of lenticular habit and has a maximum thickness of 36 inches, is composed of fine-grained white, occasionally yellowish, sugary, massive or vuggy quartz carrying small pyrite crystals and chlorite in small clots. Where the vein has pinched-out, the "fissure" is marked by a shear, 3—6 inches wide, containing slips of quartz. Calcite occurs in small veins and is common in the joints of the country rock.

The vein is broken between the surface and the 50-foot level by a strike fault, apparently a thrust throwing upwards on its south-west side. The throw is only a few feet in the north-western section of the mine, but increases to 25 feet or more in the south-western section. The hade is about 75°. In places the vein has estragged at the fault, causing reversals of dip. Other small faults and shears also occur.

In the north-western part of the mine the vein is sharply folded, the fold axes running parallel to the strike, and the limbs dipping at 40°—60°. The thrust fault apparently runs along the crest of the central folia.

Gold values are confined to the lenticular quartz bodies and average values decrease below water level.

Many other veins have been discovered in the vicinity of the mine, but are not yet being developed. Prospecting has also been carried out in the peninsula west of Port Southby.
VIII—BIBLIOGRAPHY


