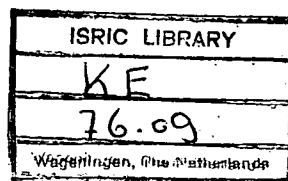


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A SEMI-DETAILED SURVEY OF THE SOUTH-NYANZA EAST AREA

(1 : 50,000)

by Job van Keulen

preliminar report no. 16'

Training Project in Pedology, Kisii, Kenya

Agricultural University of Wageningen

The Netherlands

0325

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## Preface

The soil survey presented in this report is a part of the research carried out by the Training Project in Pedology at Kisii, Kenya, a project of the Agricultural University of Wageningen. This survey was carried out by a post-graduate student as a part of his study. The survey (based on the 'detailed soil survey of the Ranen area') covers a part of the 'Kisii map-sheet'. The airphoto analyses and fieldwork was done in November and December 1975, the report was completed in December 1976.

Lack of time and irrelevant area's with regard to the detailed survey ensure this survey of some 'wet finger' area's.

## Acknowledgements

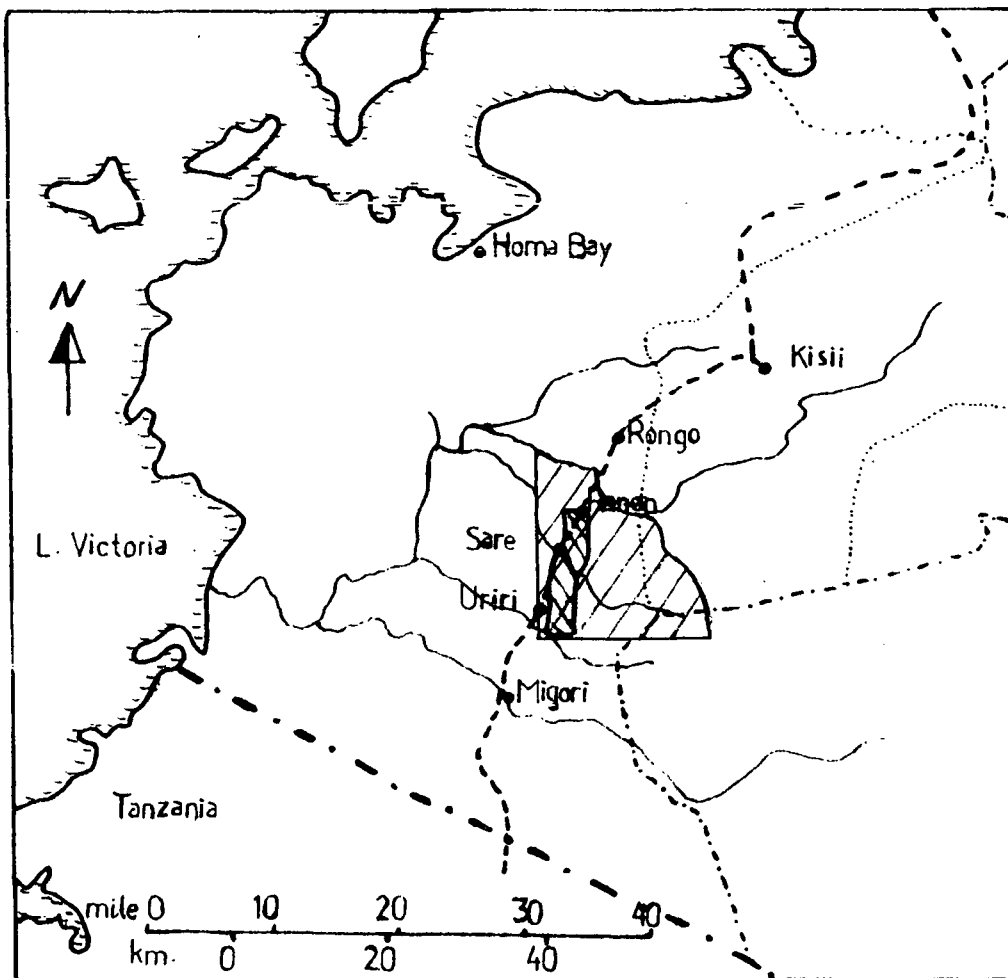
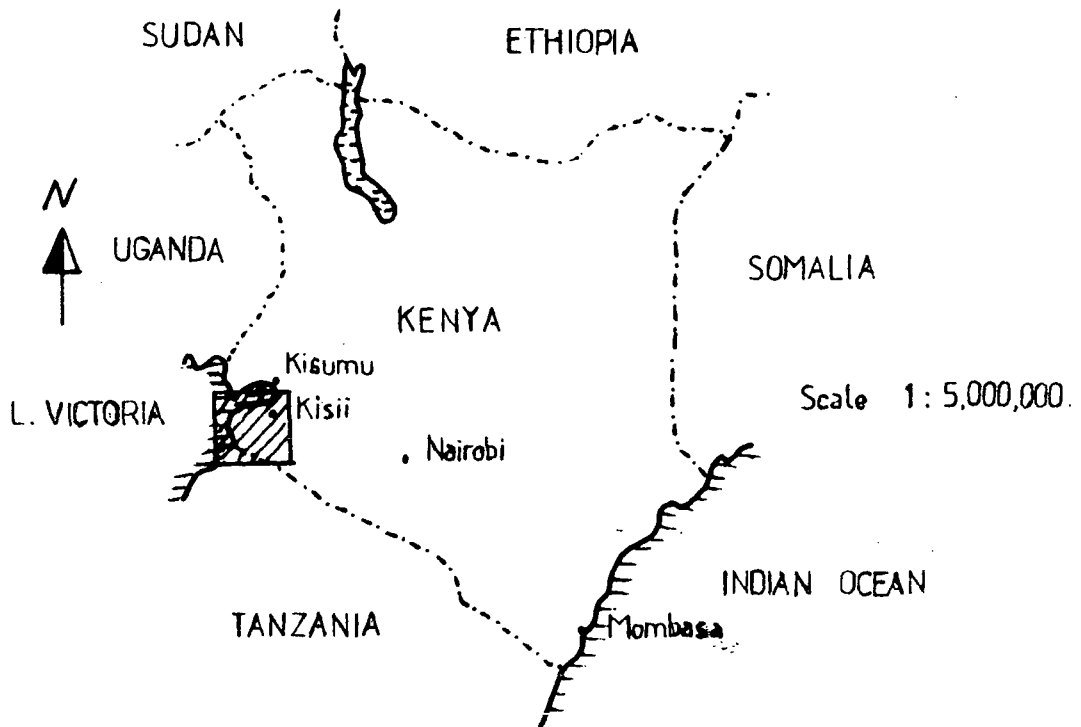
I am very grateful to Messr. Ir.W.G.Wielemaker and Ing.H.W.Boxem for the help and possibilities they gave me. Also I owe thanks to Prof. J.Bennema and Dr.Ir.T.de Neester for giving me the opportunity to join the project.

I'll have to thank Charles, Joël and Wim for helping me in the field, Piet who was willing to be my personal driver and Richard for helping me with data of his report.


PART I


General description of the area

fig.1 LOCATION MAPS



Scale 1: 1,000,000

 Rangan detailed survey area

 South-Nyanza East area



### I.1. Location and extent (see fig. 1+2)

The South-Nyanza East area is situated south-west of the Kisii Highlands, about 40 km. S.W. of Kisii. It includes partly the subdistricts East Nyokal and Kanyamkago of the South-Nyanza district (Nyanza province), South Mugirango of the Kisii district (Nyanza province), and Uasin Gishu and Siria of the Narok district (Central province). It is situated between  $34^{\circ}30'$  and  $34^{\circ}41'E.$  and  $0^{\circ}45'$  and  $1^{\circ}00'S.$ , covering the south-western half of the 'Kitere sheet' (sheet 130/3) of the 1:50,000 topogr. map of Kenya, where it is found between 667 and 689 kmE and 9889 and 9916 kmN.

The area covers appr. 32,000 ha.

The elevation ranges between 5800 and 4200 ft. (1750-1275m.) above Mombasa sealevel. The highest place is the top of a hill in the south-west of the Kisii district, the lowest is found in the utmost north-east of the area near the Gucha river.

The area is mainly inhabited by the Luo tribe. Kisii and Masai are living in the east and south-east (Kisii and Narok district).

### I.2. Climate

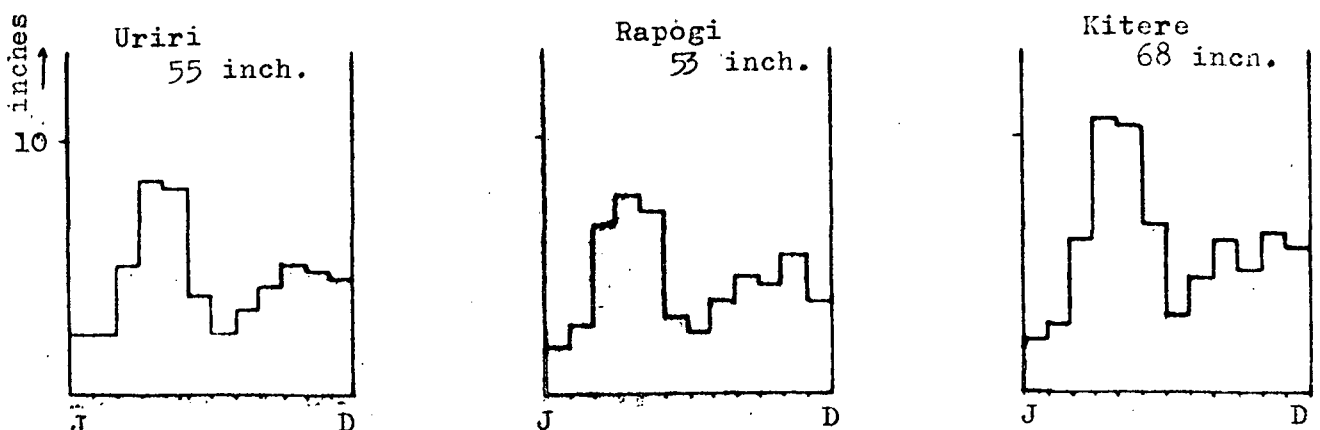
The climate is a transition of the 'monsoon climate' of the Kisii Highlands and the 'tropical savannah climate' of the lower area around Lake Victoria (Am and Aw according to Köppen-Geiger).

The mean annual temperature is about  $20^{\circ}C$ , maximum temperature  $30^{\circ}C$ , minima at night  $10-15^{\circ}C$ .

The mean annual rainfall is about 1600 mm. (1400 mm. in the west, 1700 mm. in the north-east). The rainfall is bimodal, with one real dry period during January and February, followed by the 'long rains' in April and May. A short 'dry' period in July or August proceeds the 'short rains' in October and November. In the <sup>western</sup> part of the area droughts are more pronounced. Some rainfall data of rainstations situated in or near the survey-area are given in fig. 3.

The annual evapotranspiration is about 1400-1800 mm.

fig.3





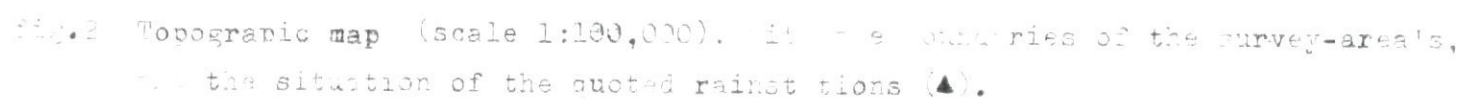
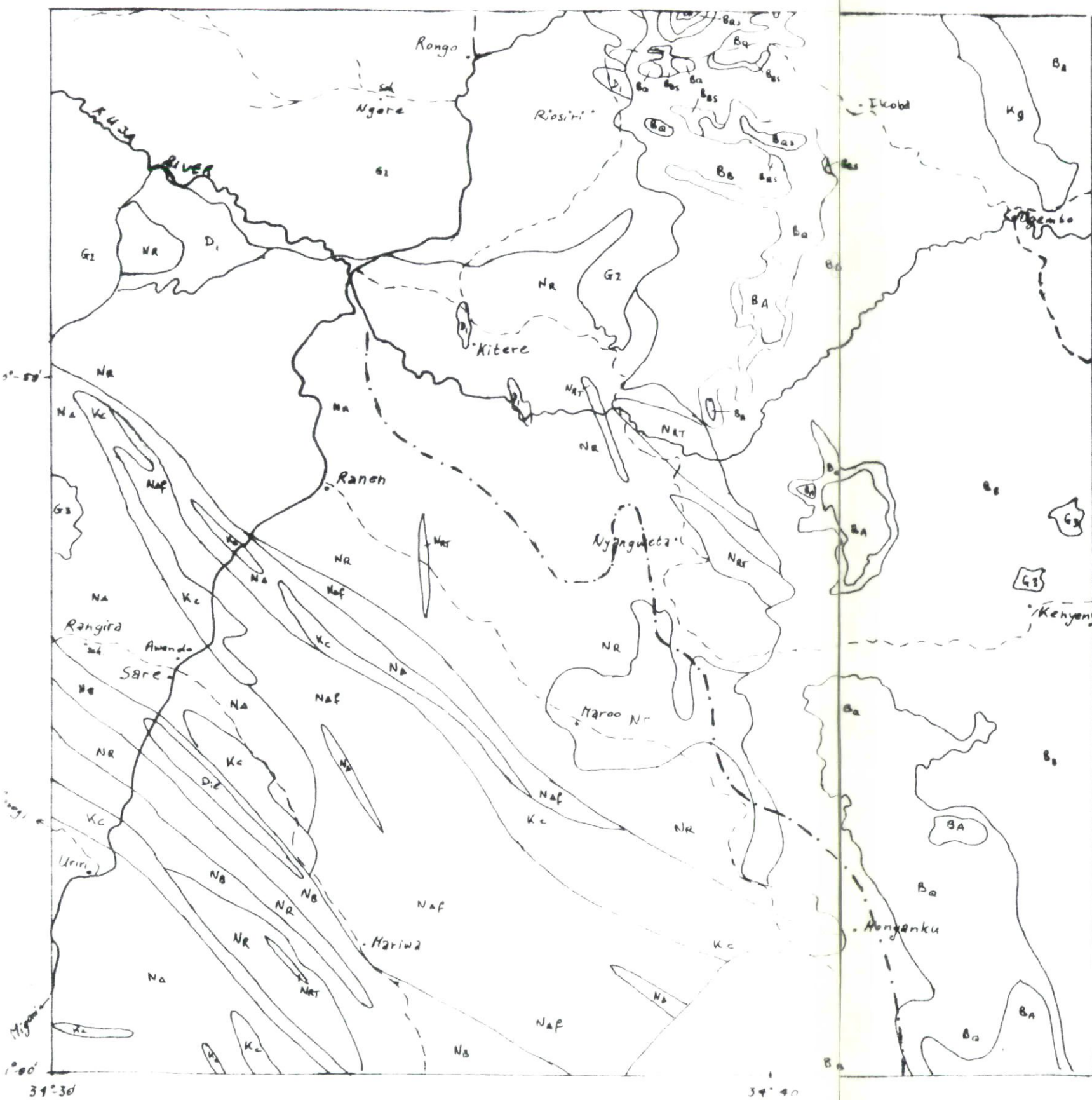






fig.4 Geological map (after Huddleston)



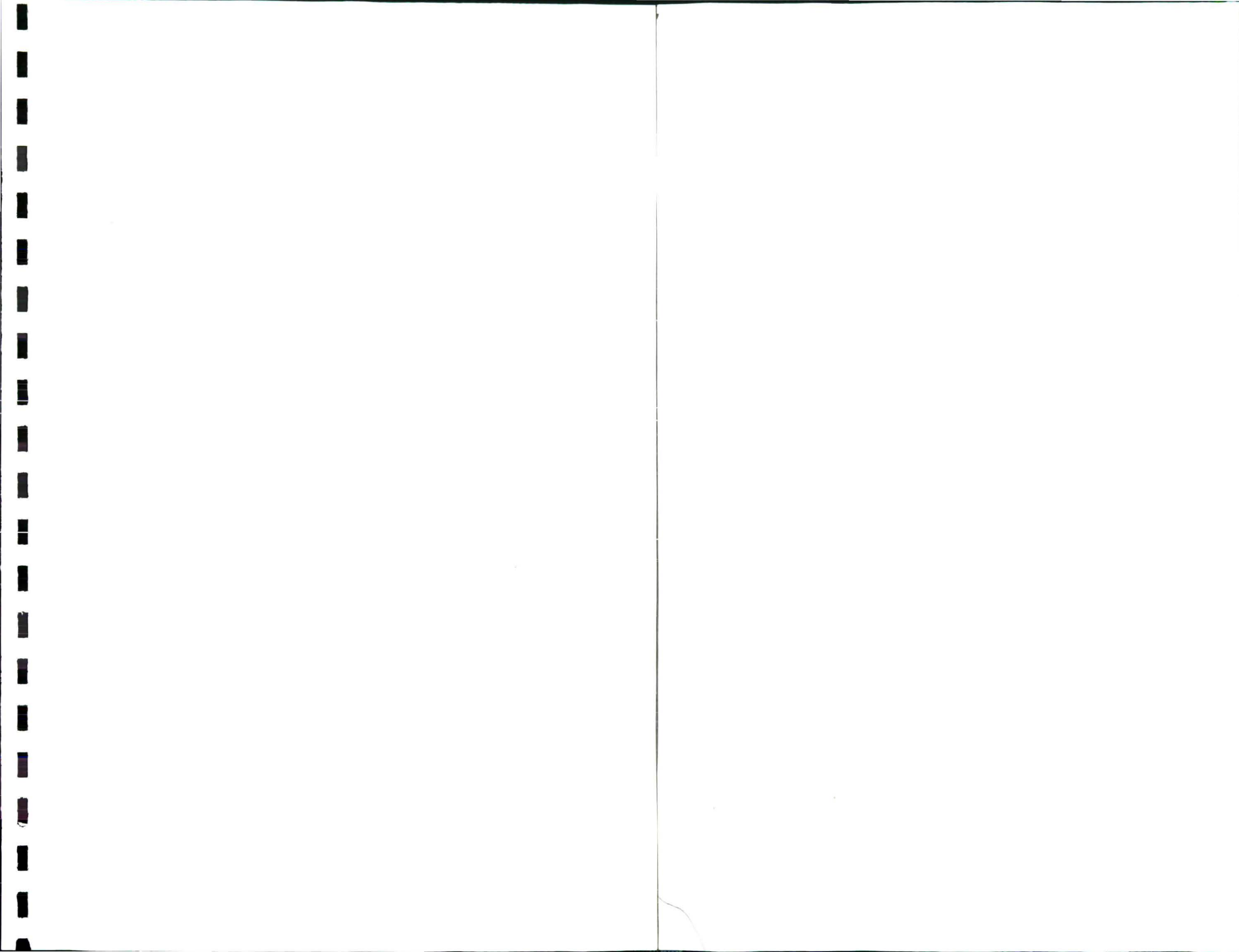
# LEGEND

TER-TIARY	Tv	Nephelinites, Nepheline-basalts & pyroclastics.
	BAR	Rhyolites & tuffs with intercalated fine- & coarse-grained sediments.
	BA	Porphyritic & non-porphyritic felsites & andesites.
	Bas	Cherts.
BUKOBAN	BQ	Quartzites.
	BB	Basalt with Kisii "Soapstone" locally developed
	BBP	Porphyritic basalt.
KAVIRONDIAN	Kc, Kg, Km	Conglomerates, grits & minor mudstones.
	Nai	Banded ironstones, cherts & shales
	NAT	Upper Andesites with intercalated tuffs & argillaceous felspathic sandstones
NY-AN-ZIAN	NR	Rhyolites & dellenites with intercalated tuffs & agglomerates
	NA	Andesites & dacites
	NAs	Basalts with minor mudstone developments.
	NB	
		INTRUSIVES
POST-KAVIRONDIAN	D3, D2, L	Younger Dolerites & Lamprophyres (D3, Post-Bukoban)
	G3	Younger Granite of Wanjare, Nyakongo, & Kenyema.
	G2	Older Granites of Kitere & Oyugis.
POST-NY-AN-ZIAN	D13, D12	Quartz-diorites associated with G2 & G3 Granites.
	Qp	Acid & Intermediate Minor Intrusives, Qu porphyry (Qp), Porphyrite (P), Hornblende porphyry (Hp), Granite-porphyry (Gp), Diorite porphyry (Dp) (Some post Kavirondian)
	D1, Die	Basic Minor Intrusives; Dolerites (D1), Epidiorites (Die)

SCALE 1:125,000

0 1 2 3 4 5 6 7 8 9 10 KILOMETRES

surveyed by A HUDDLESTON  
geologist, between August 1947 & May 1949



### I.3. Hydrology (see fig.2)

The main part of the area belongs to the catchment-area of the Sare river, running in N.W. direction. Other important rivers are the Oyani river, draining the southern part of the area in eastern direction, and some tributaries of the Gucha river, draining the northern part of the area in northern direction.

Most of the area is well drained except for the rather flat upper part of the catchment-area of the Sare river, a small area near Sare market and a rather big area in the north-west, near the Gucha river.

The area drained by the Sare river generally has broad flat valley-bottoms with poor drainage conditions.

The general slope (which is in fact the fall of the Sare river) is from about 5400 ft. in the south-east to 4300 ft. in the north-west (1600 - 1300 m.).

### I.4. Geology and parentmaterial (see fig.4)

All parentmaterials of the area are of Pre-Cambrium age. Huddleston distinguished 3 systems ; 'The Nyanzian, the Kavirondian and the Bukoban system. The Bukoban system is the youngest of them (late Pre-Cambrium). The biggest part of the area is covered with rhyolites and andesites of the Nyanzian system.

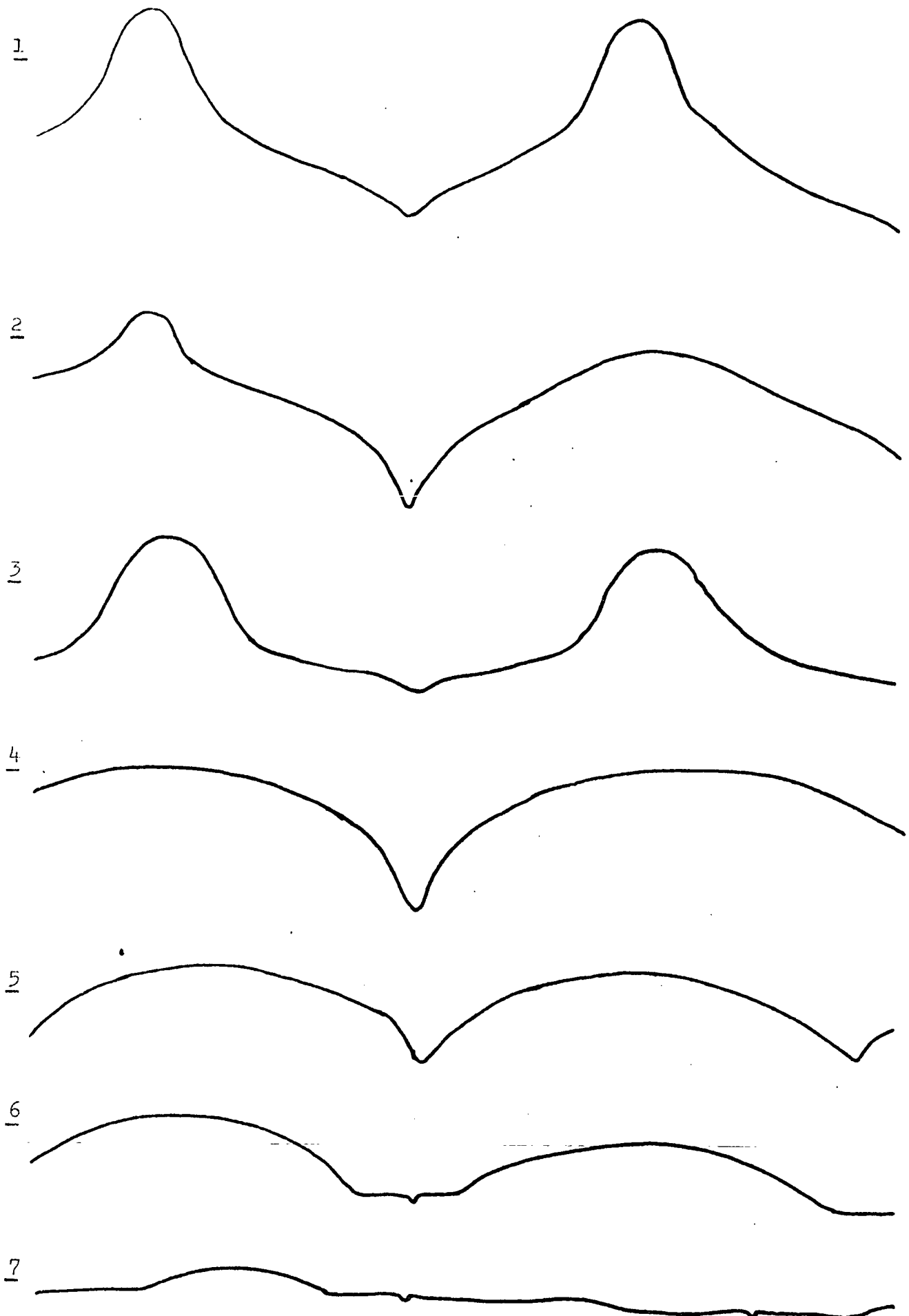
From the Bukoban system only a small area with basalts lies in the S.E. of the area

From the Kavirondian system conglomerates are found in the south-western 'half' of the survey-area, as strips within mainly andesites and some rhyolites and basalts of the Nyanzian system.

In the north-eastern 'half' mainly rhyolites and some basalts of the Nyanzian system occur.

The utmost north-west of the area covers a small part of an area where Post-Nyanzian intrusives of granites are found.

fig.5 sections illustrating the physiographic units





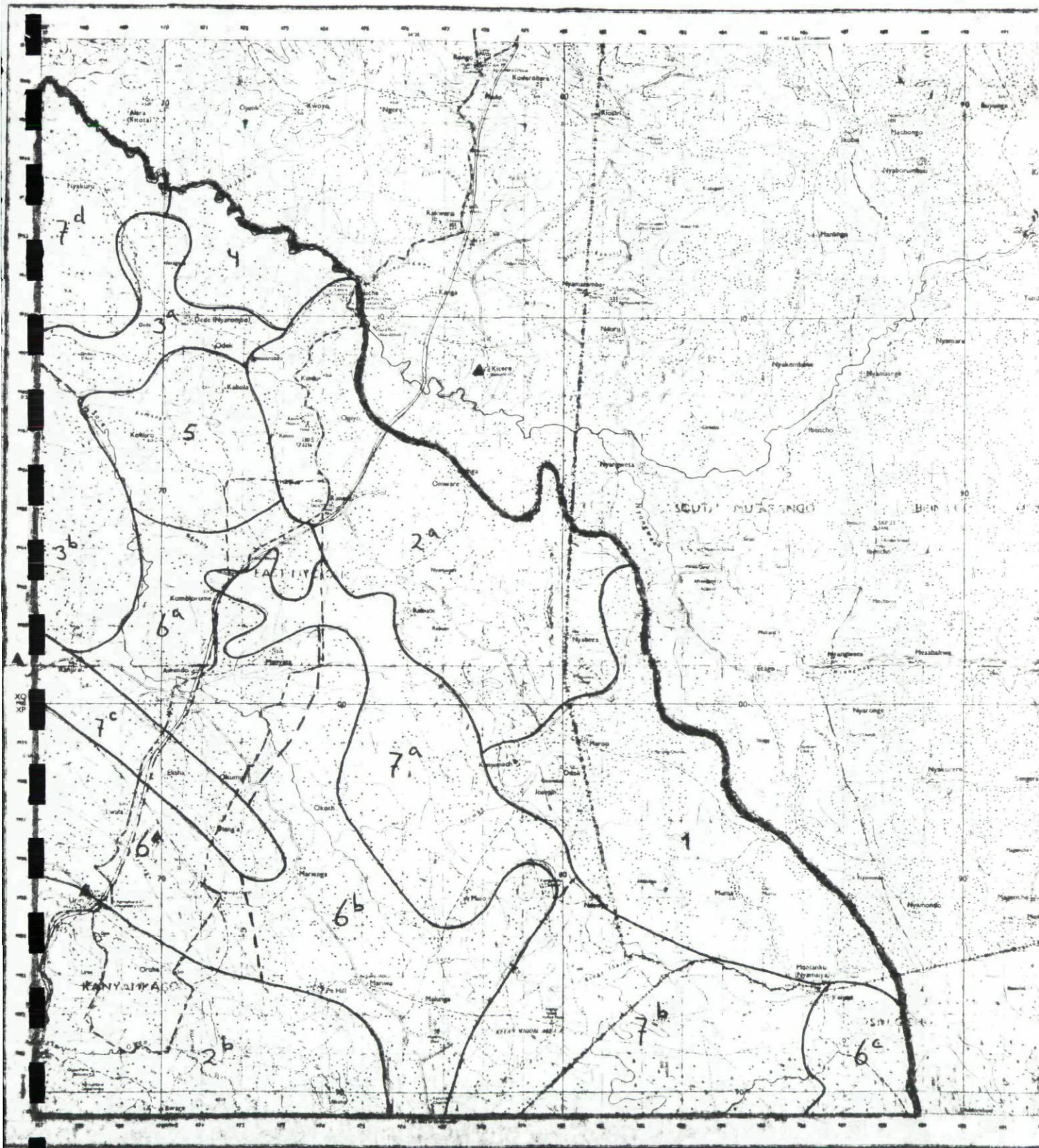
I.5. Physiography (see fig.5+6)

With the help of the physiographic map of Ir.W.G.Wielemaker, 7 physiographic units are distinguished for this area :

1. Hills with steeper tops than footslopes,  
tops occupy less than 30% of the landscape,  
slopepercentages of the footslopes are about 12%.
2. Isolated hills with steeper tops than footslopes  
in a landscape with hills with less steep tops than footslopes,  
'steeper'tops occupy less than 15% of the landscape,  
slopepercentages of the footslopes are about 12%,  
deeply incised valleys with slopes up to 20%.
3. Hills with steeper tops than footslopes,  
tops occupy up to 50% of the landscape,  
slopepercentages of the footslopes are about 7%.
4. Hills with less steep tops than footslopes,  
slopepercentages of the footslopes are about 7%.  
*deeply incised valleys with slopes up to 20%*
5. Ridges with lateral slopes between 6 and 15%,  
narrow valleys.
6. Ridges with lateral slopes between 6 and 12%,  
broad, poorly drained, valley-bottoms.
7. Flat to slightly undulating 'plains',  
slopes generally less than 5%.



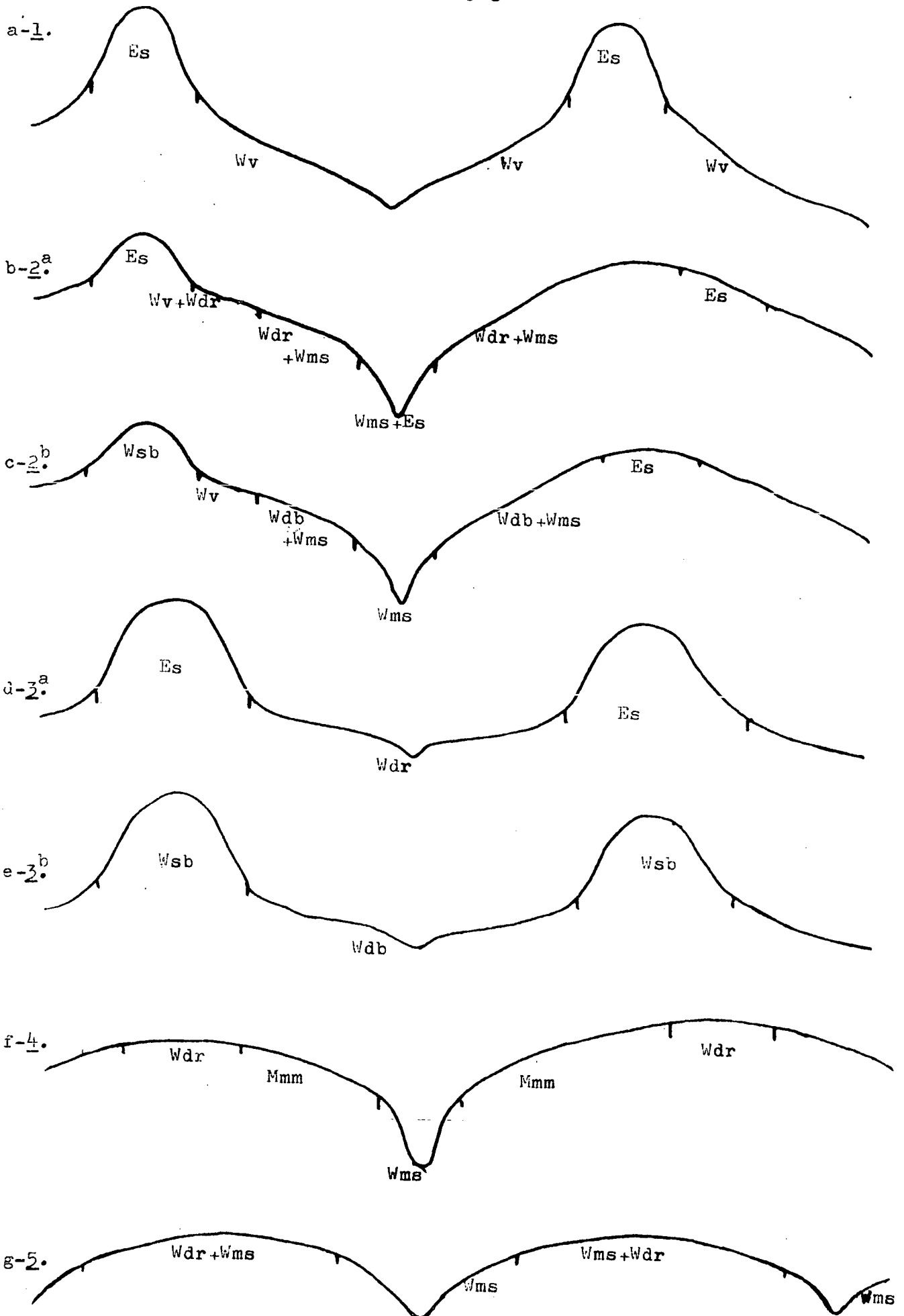
fig. 6 Physiographic division of the area also showing the subdivision for different soils, mentioned in chapter I.6. (page 14)



Scale  $\pm 1:140,000$



fig.7<sup>a-g</sup> Sections illustrating the soils of the area in the different physiographic units (see page 10 and 14)





I.6. The soils (see fig. 7<sup>a</sup>-7<sup>n</sup>)

In this chapter a brief description of the soils, occurring in the area, is given in relation to the physiography and if possible the parent material. Soils are dealt with following the division in physiographic units (see page 12 and fig. 6). Sometimes area's have been put in one phys. unit, but have different soils on similar positions. In such cases the units are subdivided.

1. Shallow, gravelly soils (Es) on tops and steep parts, mainly very deep red soils (Wv) on the footslopes. (see fig. 7<sup>a</sup>)

2<sup>a</sup>. Parent material is rhyolite.

Very shallow gravelly soils (Es) on tops and steeper parts, very deep and deep red soils on the upper part of the footslopes. (Wv+Wdr). Lower on the slope also moderately deep and gravelly soils (Wdr+WS) occur. Near the streams, slope percentages are high, and shallow to very shallow, gravelly and rocky soils occur (WS, Es)

2<sup>b</sup>. Parent material is andesite.

As 2<sup>a</sup>, but <sup>often</sup> shallow soils are not gravelly and have boulders (Wsb). Also deeper soils are often formed over boulders or have only a thin layer of rotten rock. (Wdb)

The Oyani river occurring in this area runs through a rather broad valley with poorly drained soils (Ppm).

3<sup>a</sup>. On rhyolite.

Very shallow, gravelly soils (Es) on tops and steeper parts, deep to moderately deep red soils on the footslopes (Wdr).

3<sup>b</sup>. On granite and andesite.

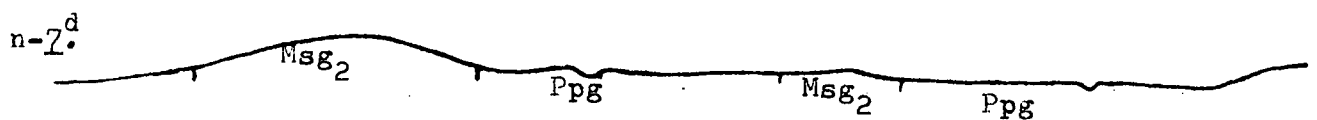
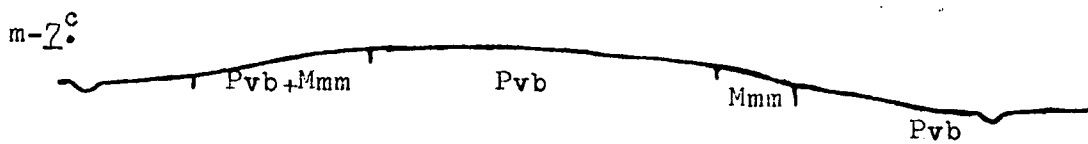
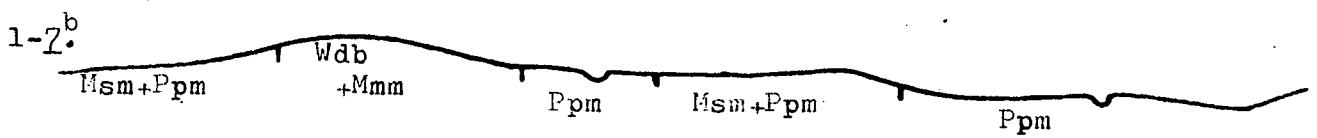
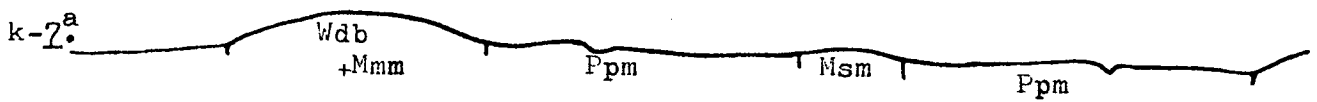
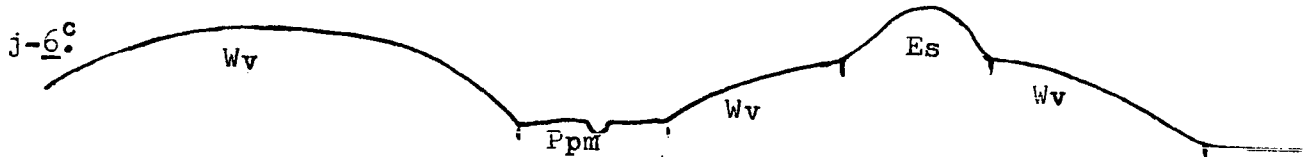
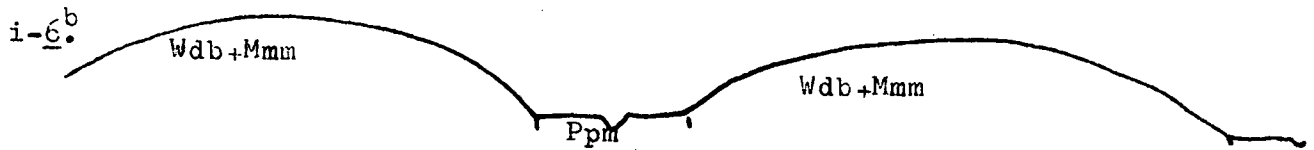
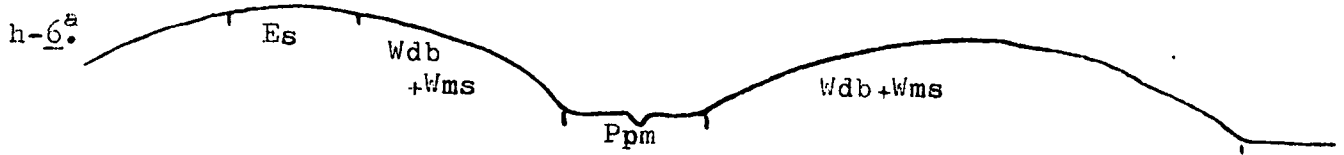
Tops have shallow soils with boulders (Wsb), the footslopes moderately deep red soils over a thin layer of rotten rock or hard rock (Wdb). Where slope percentages are very low and near Sare river planosols occur (Ppm).

4. Well drained deep red soils on top, moderately well drained reddish brown soils, with a mottled subsoil (Mm) in the middle part and moderately deep to shallow, gravelly soils (Wms) on the lower part of the slope.

5. On rhyolite.

Moderately deep to shallow, gravelly soils on tops, steeper parts and valley slopes (WS, Es). Moderately deep to deep red soils (Wdr) where slope percentages are low.

fig. 7<sup>h-n</sup> (see fig. 7<sup>a-g</sup>)







- 6<sup>a</sup> Moderately deep to shallow, sometimes very shallow soils on tops and steeper parts (Wms,Es), moderately deep to deep red soils over a thin layer of rotten rock (Wdb) on less steep slopes. Planosols are found at the valley-bottoms (Ppm).
- 6<sup>b</sup> Transition between 6<sup>a</sup> and 7<sup>a</sup>, i.e. between an area with ridges and a more or less flat area. In general the drainage is worse. On the lateral slopes of the ridges, where slopepercentages are low, moderately well drained soils with a mottled subsoil (Mmm) occur. Other soils like 6<sup>a</sup>.
- 6<sup>c</sup> On basalt.  
Similar to 6<sup>a</sup>, but only on steep tops shallow, gravelly soils (Es) occur. All other well drained soils are very deep red soils (Wv).
- 7<sup>a</sup> Soils like in 6<sup>a+b</sup>. Only 20% of the landscape is formed by very low ridges, with well to moderately well drained soils similar to 6<sup>a+b</sup>. In the poorly drained 'planosol' area of this landscape higher parts with a somewhat better drainage are found, having moderately well drained gravelly soils often with ironstone (Msm).
- 7<sup>b</sup> Here the 'ridges' are almost flat and have poor drainage conditions. On higher places moderately well drained, sometimes gravelly soils on ironstone (Mmm,Msm) occur. All other soils are planosols (Ppm). On some steep parts (5%) well drained soils occur (Wdb).
- 7<sup>c</sup> Parentmaterial is basalt.  
The poorly drained soils of this area are a kind of vertisols (<sup>Pvb</sup>) Besides these soils only moderately well drained, reddish brown soils are found on the steeper slopes. (Mmm)
- 7<sup>d</sup> Parentmaterial is granite.  
Higher places have mainly shallow, sandy soils over ironstone (Msg), lower places planosols with a bleached, sandy loam topsoil (Ppg).



## I.7. Vegetation and landuse

In most of the area the original vegetation has disappeared. Only in the poorly drained area's and in the utmost south-east<sup>where</sup> the Masai tribe is living the natural vegetation remained. In the poorly drained area's the vegetation consists of grasses and scattered bushes on termite-mounts. On drier soils and near streams a rather dense, sometimes very dense bush vegetation is found.

According to the 1:250,000 Climate and Vegetation Map of South-West Kenya the south-east and northern part of the area belongs to the 'Western Combretium Savannah zone'. The middle part, which coincides with the areas with a rather flat topography and poor drainage conditions, belongs to the 'Western Diosphyros zone'. The eastern part (Kisii district) belongs to the 'Western Moist Forest zone'.

The landuse is strongly related to the drainage of the soils and to the tribes living in the area. In the Kisii area soils are dry and intensively used for all kinds of cash- and subsistence-crops.

The Luo area has many wet soils. The dryer soils are used for all kinds of subsistence-crops and some cash-crops, mainly sugarcane. About 30% of these soils is fallow and used for grazing. The wet soils are mainly used for extensive grazing, but if better, drier soils are rare, they are also used for maize, millet etc., and also for sugarcane.

The Masai, living in the area, only use their land for grazing.

PART II

The soilmap

## II.1. Survey methods and materials

The South-Nyanza East survey is mainly based on the Ranen detailed survey. Also data from the Kisii West and Rangwe survey have been used. Using data of these surveys, preliminar boundaries mainly <sup>based</sup> on relief were sketched on 1:50,000 areal pictures, with the help of a stereoscoop. These preliminar boundaries were checked in the field and corrected. About 50 augerings have been made.

The resulting soilmap was transferred on the 1:50,000 top-sheet of the area using a sketchmaster. The map with soilboundaries and other important data has been traced and multiplied.

The materials which have been used for the fielwork are an 'Edelman' auger an 'Abney' level, 'Munsell' cholorcharts and Soil Profile Description Forms of the K.S.S.P.

The airphoto analyses was done with 1:50,000 aireal pictures of 1960, and a Topcon mirror stereoscoop.

As a basemap the 1:50,000 topsheet of the Kitere area was used (series 4731, sheet 130/ 3, edition 4). The soilboundaries were transferred from the photo's to the top sheet with a 'Keuffel and Essen' vertical sketchmaster.

## II.2. Crîtérions for distinction of the soilseries

For the distinction of the soilseries the Soil Survey Manual has not strictly been followed. In fact most series in this survey have a too wide range in characteristics to be called soilseries according to the S.S.M. The soils of the series are uniform in their most pronounced characteristics. Similar soils on strongly diverging slopes have not been called different soilseries, but they have different slope-phases.

The main criterion is the drainage. Four classes have been formed :

1. Poorly drained soils
2. Moderately well drained soils
3. Well drained soils
4. (somewhat) Excessively drained soils

The soils of the first three classes have been subdivided.

The poorly drained soils are subdivided in 3 groups according to the presence of a bleached topsoil, the texture of the topsoil and the presence of an abrupt textural change

1. (Ppm) A bleached non-sandy topsoil above an abrupt textural change
2. (Ppg) A bleached sandy topsoil above an abrupt textural change
3. (Pvb) No bleached topsoil and no abrupt textural change

The moderately well drained soils are subdivided according to the depth of the soil, the texture of the topsoil and the presence of (surface) gravel

1. (Msm) Shallow to moderately deep, gravelly, clayloam soils
2. (Msg<sub>2</sub>) Mainly shallow, non-gravelly, sandy, loam to clayloam soils
3. (Mmm) Moderately deep to deep, non gravelly, clayloam soils

The well drained soils have been subdivided according to depth, presence of (surface) gravel and the thickness of the rotten rock layer

1. (Wsb) Shallow to very shallow soils on boulders
2. (Wms) Moderately deep to shallow soils with gravel
3. (Wdr) Moderately deep to deep soils over a thick layer of rotten rock
4. (Wdb) Moderately deep to deep soils over a thin layer of rotten rock
5. (Wv ) Very deep soils

For the soildepth classes see page 21.

### I.3. The legend of the soilmap

To indicate the soilproperties of the mapping units the following symbols have been used:

Wdr(+Wv) — Symbol(s) indicating the soilseries  
 A( B) \ Symbol(s) indicating the slopeclass(es)

Explanation of the series symbols:

#### Poorly drained soils

Ppm : Dark gray, heavy clay soils, with a bleached, siltloam topsoil often above an abrupt textural change.

(planosols, gleyic luvisols)

Ppg : Grayish brown, sandy loam soils, with a gray heavy clay subsoil (or over ironstone), on granite.

(planosols, gleyic luvisols)

Pvb : Black to dark gray, cracking, heavy clay soils, on basalt.

(pellic vertisols)

#### Moderately well drained soils

Msm : Shallow to moderately deep, dark brown to dark gray, gravelly, clayloam to loam soils, often on ironstone.

(cambisols, phaeozems)

Msg<sub>2</sub> : Mainly shallow, dark brown to reddish brown, sandy, loam to clayloam soils, mainly on ironstone covering granite rock.

(mainly phaeozems and cambisols, some luvisols)

Mmm : Moderately deep to deep, reddish brown, clayloam to clay soils, with a mottled subsoil, sometimes overlying gray heavy clay or ironstone. (luvisols (gleyic and chromic))

Well drained soils

- Wsb :Shallow to very shallow, dark brown to reddish brown, very stony and rocky clayloam soils, with boulders, on andesite and granite.  
(mainly (lithic)phaeozems)
- Wms :Moderately deep to shallow, brown to reddish brown, gravelly clayloam to light clay soils, with a cambic or sometimes an argillic B.  
(mainly cambisols and phaeozems, some luvisols)
- Wdr :Moderately deep to deep, reddish brown to red, claysoils, with a clear argillic B, overlying a thick layer of rotten rock.  
(luvisols)
- Wdb :Moderately deep to deep, reddish brown clay soils, with a clear argillic B, overlying a thin layer of rotten rock or hardrock, mainly over andesite.  
(luvisols)
- Wv :Very deep, reddish brown to red, clay soils, with a clear argillic B, mainly on rhyolite and basalt.  
(nitosols,luvisols)  
(somewhat) Excessively drained soils
- Es :Very shallow to shallow, very gravelly, stony and rocky soils.  
(lithosols,regosols)

Depth classes used for this legend are:

very shallow	:less than 20cm. deep
shallow	:20 to 50cm.
moderately deep	:50 to 100cm.
deep	:100cm. soildepth to 150cm. depth of the arg.B.
very deep	:argillic B continues below 150cm.

Slopepercentage classes used are:

- A :0-2%  
B :2-5%  
C :5-8%  
D :8-16%  
E :16-30%  
F :30% or more.

The names of the soilseries are composed of abbreviations of properties of the series.

The (first)capital refers to the drainage class, as shown by the underlined capitals in the description given above.

The first miniscule is an abbreviation of the soildepth class, except for the poorly drained soils, where it indicates the classification.

The second miniscule refers to the parent material the kind of weathering, or sometimes, also to the depth of the soils.

#### II.4. Description of the soil-associations

In many mapping units 2 soilseries occur, which cannot be mapped separately on this scale. This is shown on the map as associations, by giving 2 soilseries-symbols in one unit. The first symbol indicates the series, which covers the biggest part of the mapping-unit.

In this chapter a description of the occurring associations is given.

Pvb+Mmm - (about 80:20%)

This association occurs in landscape 7<sup>c</sup> (see fig. 7<sup>m</sup>), some steeper parts in the slopes of this plateau have moderately well drained soils.

Ppm+Msm - (about 90:10%)

This association mainly occurs in landscape 7<sup>a</sup> (see fig. 7<sup>k</sup>), where in the poorly drained 'planosol area' often somewhat drier places with shallow 'ironstone soils' are found.

Msm+Ppm - (about 50:50%)

This ass. covers the flat parts of the landscape 7<sup>b</sup> (see fig. 7<sup>l</sup>), where shallow soils with a more or less bleached topsoil, alternate with planosols.

Wdb+Mmm - (about 60:40%)

This ass. covers the ridges of landscape 6<sup>b</sup> (see fig. 7<sup>i</sup>), which are low and have moderately well drained soils on the lower and less steep parts of the lateral slopes.

Wsb+Wdb - (about 80:20%)

In some higher parts of landscape 3<sup>b</sup> (see fig. 7<sup>e</sup>) small area's with less steep slopes and deeper soils are found.

Wms+Wdr - (about 70:30%)

This one covers the upper part of the ridges in landscape 5 (see fig. 7<sup>g</sup>). Most soils are shallow and gravelly, only on less steep parts in long slopes deeper soils are found.

Wdr+Wms - (about 70:30%)

Covers the upper part of the hills with less steep tops than footslopes of landsc. 2<sup>a</sup> (see fig. 7<sup>b</sup>). Most of the soils are deep and red, but on tops and steeper places often shallow gravelly soils occur.

Wdb+Wms - (about 70:30%)

Like the previous one, but on andesite.

It covers the upper part of the hills with less steep tops than footslopes of landsc. 2<sup>b</sup> (see fig. 7<sup>c</sup>), and the dry part of the 'ridge landscape' 6<sup>a</sup> (see fig. 7<sup>h</sup>).

Wdr+Wv - (about 60:40%)

This association covers upper footslopes of hills with steeper tops than footslopes in landscape 2<sup>a</sup> (see fig. 7<sup>b</sup>). On less steep

parts or long slopes, soils with an argillic B. deeper than 150cm. occur.

Wv+Wdr - (about 70:30%)

In landscape 1 (see fig.7<sup>a</sup>), this association occurs on the steeper valley-slopes, where some deep red soils do not have a argillic B. deeper than 150cm.

Wms+Es - (about 70:30%)

This association covers the valley-slopes of landscape 2<sup>a</sup> (see fig.7<sup>b</sup>), where rock-outcrops and very shallow soils alternate with deeper gravelly soils. The shallow soils often occur on the steeper parts.

## II.5. Description of the soilseries

Only a brief description of the soils is given. For a more extended description see other surveys, as shown under 'Similar soils'.

One should keep in mind, that soilseries, which are described in this report, allways have a bigger range in characteristics than soilseries of detailed survey's, mentioned under 'Similar soils'.

Ppm : Dark gray, heavy clay soils, with a bleached, siltloam topsoil often above an abrupt textural change.

Classification F.A.O.(1974) : 90% eutric planosols, 2  
10% gleyic phaeozems + gleyic luvisols.

Surface in hectares (estimated) : 6900 ha. (20% of the area)

Soil characteristics : poorly drained soils with a very dark gray to dark grayish brown, siltloam to clayloam topsoil, with dark brown mottles. Most of the soils have a more or less clear, gray to light gray eluviation horizon with a siltloam texture above a heavy clay subsoil, which has yellowish to red, prominent mottles in top, and a prismatic to columnar structure. Often slickensides are found.

Environmental characteristics : the series is found at lower and poorly drained places, with a flat topography, mainly over rhyolite and andesite. Similar soils described in other survey's are the soils of the Riana-kuna series of the Ranen det. survey.

Ppg : Poorly drained, grayish brown, sandy loam soils with a gray heavy clay subsoil (or over ironstone), on granite.

Classification F.A.O.(1974) : 80% dystic planosols,  
20% dystic gleysols.

Surface in hectares (estimated) : 600 ha. (2% of the area)

Soil characteristics : poorly drained soils with a very dark gray to dark brown, sandy loam to sandy clayloam topsoil, with dark brown mottles, a bleached, gray to light gray, eluviation horizon above a heavy clay subsoil, which has yellowish to red, prominent mottles in top, and a prismatic to columnar structure. Often slickensides are found.

Environmental characteristics :as Ppm, but over granite.

Similar soils are described in the South Nyanza N.E. survey (Ppg)

Pvb :Poorly drained, black to dark gray, cracking, heavy clay soils, on basalt.

Classification F.A.O.(1974) :pellic vertisols.

Surface in hectares (estimated) :1400 ha.(5% of the area)

Soil characteristics :poorly drained soils, with a black to dark gray, heavy clay topsoil, often with dark brown mottles, over a dark gray heavy clay subsoil, with prominent brown mottles, and many intersecting slickensides.

Environmental characteristics :these soils are found on a kind of plateau near Sare market. The parentmaterial is basalt.

Similar soils are described in the Ranen det. survey (Awundo series).

Msm :Moderately well drained, shallow to moderately deep, dark brown to dark gray, gravelly, clayloam to loam soils, often on ironstone.

Classification F.A.O.(1974) :70% haplic phaeozems,

20% eutric cambisols,

10% luvisols.

Surface in hectares (estimated) : 1500 ha.(5% of the area)

Soil characteristics :moderately well drained, clayloam to loam soils, with a very dark brown to dark brown, gravelly topsoil. Sometimes an argillic B. horizon is found, with a gravelly, clayloam texture, somewhat redder and lighter colours and yellowish brown mottles. Downwards in the profile the percentage gravels increases. (gravels are rotten rock pieces and ironstone concretions) The rotten rock, starting within 70 cm., is often covered with a ,not allways continuous, layer of ironstone.

Environmental characteristics :the soils often occur on the higher and somewhat better drained places in the poorly drained area's.

Similar soils are described in the Ranen and Rangwe det. survey (Oboke series) and the South Nyanza North-East survey (Msm)

Msg<sub>2</sub> :Moderately well drained, mainly shallow, dark brown to reddish brown, sandy, loam to clayloam soils, mainly over ironstone covering granite rock.

Classification F.A.O.(1974) :50% haplic phaeozems,

40% eutric cambisols,

10% luvisols.

Surface in hectares (estimated) :800 ha. (3% of the area)

Soil characteristics :moderately well drained soils, with a dark brown



sandy, loam to clayloam topsoil. Some times a cambic or argillic E. is found with reddish brown colours, and mottling. The rotten rock, which is often covered with ironstone, starts within 50cm. In the lower part of the profile many ironstone concretions are found.

Environmental characteristics :like Msm, but over granite. (M<sub>sg1</sub>)  
Similar soils are described in the South Nyanza N.E. survey (M<sub>sg2</sub>).

Mmm :Moderately well drained, moderately deep to deep, reddish brown, clayloam to clay soils, with a mottled subsoil, sometimes overlying gray heavy clay or ironstone.

Classification F.A.O.(1974) :luvisols (gleyic and chromic),  
luvic phaeozems.

Surface in hectares (estimated) : 1500 ha.(5% of the area)

Soil characteristics :moderately well drained clayloam to clay soils, with a dark brown topsoil and a (somewhat) heavier textured, reddish brown, mottled, B.horizon. The lower part the B.horizon often has iron-manganese concretions. The subsoil is mostly formed by ironstone over rotten rock, sometimes it is gray heavy clay.

Environmental characteristics :these soils are found on ridges, where the drainage conditions are bad, and where planosols are becoming red, because of an improvement in drainage.

Similar soils are described in the South Nyanza N.E. survey (Mmm).

Wsb :Well drained, shallow to very shallow, dark brown to reddish brown, very stony and rocky clayloam soils, with boulders, on andesite and granite.

Classification F.A.O.(1974) :80% (lithic) haplic phaeozems,  
20% (lithic) eutric cambisols.

Surface in hectares (estimated) : 800 ha.(3% of the area)

Soil characteristics :well drained, shallow to very shallow, clayloam to clay soils, with a dark brown topsoil and sometimes a B-horizon, directly overlying the hardrock, which is formed by big boulders, giving the soils a big range in depth over short distances.

Environmental characteristics :these soils are found on tops of hills and ridges. The parentmaterial is andesite or sometimes granite.

Similar soils are described in the Ranen det. survey (Uriri series).

Wms :Well drained, moderately deep to shallow, brown to reddish brown, gravelly clayloam to light clay soils, with a cambic or sometimes an argillic B.

Classification F.A.O.(1974) :50% chromic cambisols,  
40% haplic phaeozems,  
10% chromic luvisols.

Surface in hectares (estimated) : 4700 ha. (14% of the area)

Soil characteristics : well (sometimes somewhat excessively) drained gravelly soils, with a dark brown to dark reddish gray, clayloam topsoil, often over a redder, sometimes heavier textured, cambic or argillic B, which is mostly mixed with rotten rock. Below these, a thick layer of rotten rock is found ( $\pm$  1m.)

Environmental characteristics : the series is found on the slopes of river-valleys, tops and steeper parts of the lateral slopes of ridges and on the transition between very shallow and deeper soils. The parent-material is mainly rhyolite and andesite.

Similar soils are described in the Ranen and Rangwe detailed surveys (Marando series).

Wdr : Well drained, moderately deep to deep, reddish brown to red, clay soils, with a clear argillic B., overlying a thick layer of rotten rock. Classification F.A.O. (1974) : chromic luvisols.

Surface in hectares (estimated) : 3300 ha. (10% of the area)

Soil characteristics : well drained, clay to clayloam soils, with a clear weak red to red argillic B, with a clay texture, below a dark reddish brown, somewhat lighter textured topsoil. A rather thick horizon with B- and rotten rock material is found ( $\pm$  40cm.), beginning within 150cm.

Environmental characteristics : the soils are found on footslopes and lateral slopes of ridges. The parent material is mainly rhyolite.

Similar soils are described in the Ranen detailed survey (Rabour series).

Wdb : Well drained, moderately deep to deep, reddish brown, clay soils, with a clear argillic B., overlying a thin layer of rotten rock or hardrock.

Classification F.A.O. (1974) : chromic luvisols.

Surface in hectares (estimated) : 4500 ha. (14% of the area)

Soil characteristics : like Wdr, but often a somewhat lighter texture, less red colours and a thin layer of rotten rock, or even no rotten rock at all.

Environmental characteristics : like Wdr, but the parent material is mainly andesite.

Similar soils are described in the Ranen detailed survey (Manyata series)

Wv : Well drained, very deep reddish brown to red, clay soils, with a clear argillic B.

Classification F.A.O. (1974) : eutric nitosols,  
chromic luvisols.

Surface in hectares (estimated) : 2800 ha. (13% Of the area)

Soil characteristics :like Wdr, but the B3-horizon starts below 150cm.

Environmental characteristics :these soils are found on the rather straight middle part of footsslopes. In general the parent material is rhyolite or basalt.

Similar soils are described in the Ranen detailed survey (Ranen series).

Es : (somewhat) Excessively drained, very shallow to shallow, very gravelly, stony and rocky soils.

Classification F.A.O.(1974) : 50% lithosols,  
50% eutric regosols (lithic phase).

Surface in hectares (estimated) : 1600 ha. (7% of the area)

Soil characteristics : A thin, dark brown to brown, gravelly, loam to clayloam topsoil, over soft or hard rock, with many joints filled with topsoil material.

Environmental characteristics : the series is found on tops and steeper places of hills and ridges. The parent material may be rhyolite or basalt, sometimes andesite.

Similar soils are described in the Ranen det. survey (Oreru series).

## Appendix

Correlation with the 'Draft legend of the Kisii map-sheet'

(Dec. 1975)

Ppm	- Peh <sub>1</sub> , Rwc, KwC <sub>2</sub>
Ppg	- Peg
Pvb	- PvV <sub>1</sub>
Msm	- PiM
Msg <sub>2</sub>	- RsmC <sub>2</sub>
Mmm	- RmM <sub>3</sub>
Wsb	- RsprA/G
Wms	- RssM, Kss, RmM <sub>1</sub> , RmM <sub>2</sub>
Wdr	- KmM <sub>1</sub> , KmG <sub>1</sub> (R)
Wdb	- RmM <sub>2</sub> , RmG
Wv	- KdG(R), KdM <sub>1</sub>
Es	- Rsp, Ksp

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Wdr(,Wv) — Soilseries symbol(s)  
 A( B) — Slopeclass symbol(s)

The series:

Poorly drained soils

- Ppm :Dark gray, heavy clay soils, with a bleached, siltloam topsoil, often above an abrupt textural change. (planosols, gleyic luvisols)  
 Ppg :Grayish brown, sandy loam soils, with a gray heavy clay subsoil (or over ironstone), on granite. (planosols, gleyic luvisols)  
 Fvb :Black to dark gray, cracking, heavy clay soils, on basalt. (pellic vertisols)

Moderately well drained soils

- Msm :Shallow to moderately deep, dark gray to dark brown, gravelly, clayloam to loam soils, often on ironstone. (cambisols, phaeozems)  
 Msg<sub>2</sub> :Mainly shallow, dark brown to reddish brown, sandy, loam to clayloam soils, mainly on ironstone, covering granite rock. (phaeozems, cambisols)  
 Mmm :Moderately deep to deep, reddish brown, clayloam to clay soils, with a mottled subsoil, sometimes overlying gray, heavy clay or ironstone. (gleyic and chromic luvisols)

Well drained soils

- Wsb :Shallow to very shallow, dark brown to reddish brown, very stony and rocky clayloam soils, with boulders, on andesite and granite. ((lithic)phaeozems)  
 Wms :Moderately deep to shallow, brown to reddish brown, gravelly, clayloam to light clay soils, with a cambic or sometimes an argillic B. (mainly cambisols and phaeozems, some luvisols)  
 Wdr :Moderately deep to deep, reddish brown to red, clay soils, with a clear argillic B, overlying a thick layer of rotten rock. (luvisols)  
 Wdb :Moderately deep to deep, reddish brown, clay soils, with a clear argillic B, overlying a thin layer of rotten rock or hardrock, mainly over andesite. (luvisols)  
 Wv :Very deep, reddish brown to red, clay soils, with a clear argillic B, mainly on rhyolite and basalt. (nitosols, luvisols)

(somewhat) Excessively drained soils

- Es :Very shallow to shallow, very gravelly, stony and rocky soils. (lithosols, regosols)

Depth classes :

- very shallow :less than 20cm.  
 shallow :20 to 50cm.  
 moderately deep:50 to 100cm.  
 deep :100cm. soildepth to 150cm. depth of the arg.B.  
 very deep :arg.B deeper than 150cm.

Slope classes :

- A :0-2%  
 B :2-5%  
 C :5-8%  
 D :8-16%  
 E :16-30%  
 F :30% or more.



