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GEOLOGICAL SURVEY DEPARTMENT

THE GEOLOGY
OF THE
NCHEU-BALAKA AREA

by

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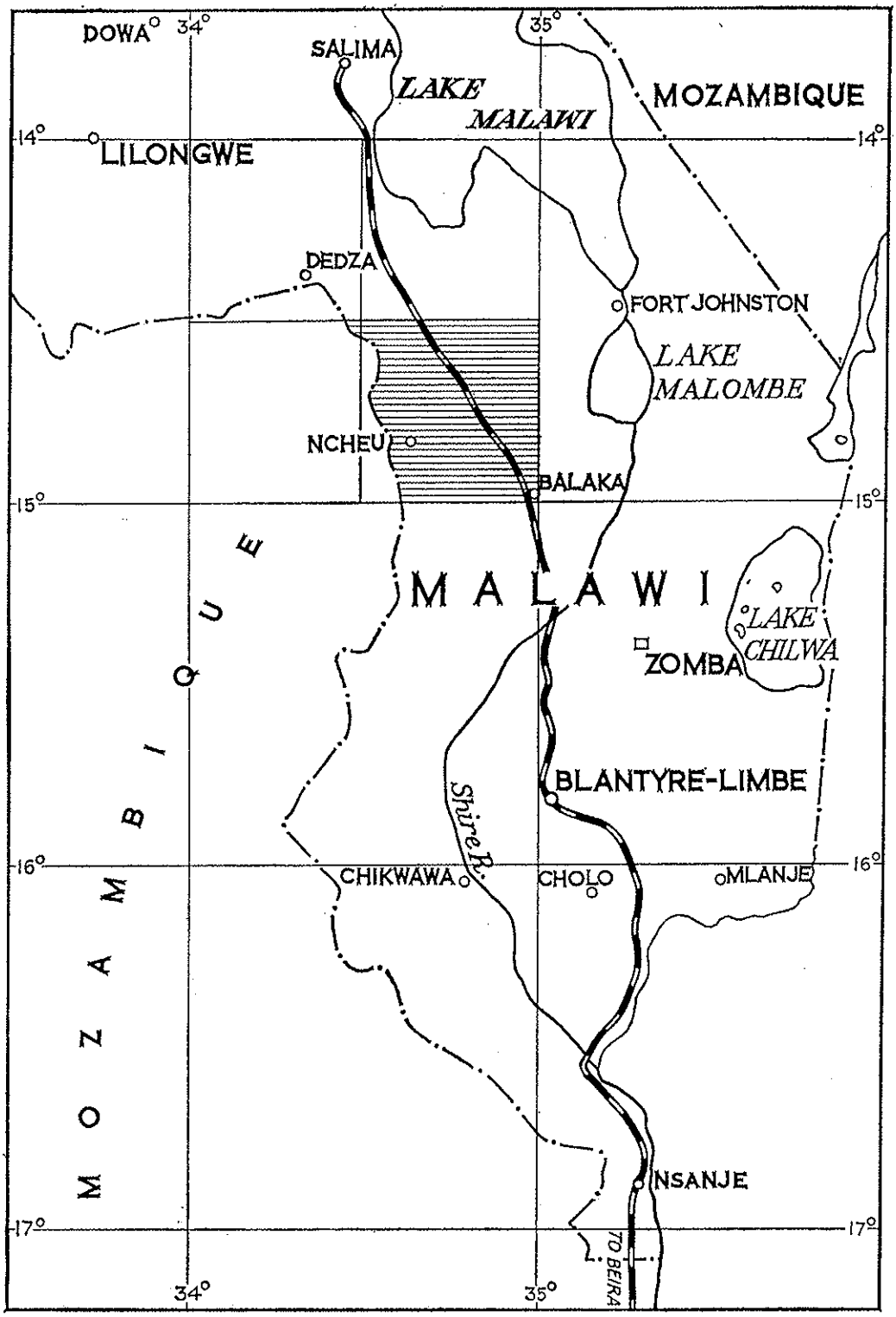

FIG. 1. Location of the Ncheu–Balaka area.

Balaka is connected to southern Malawi by two roads to Blantyre; one, via Liwonde and Zomba, of 94 miles and the other, via Matope, of 77 miles. These roads converge five miles to the north-west of Balaka and continue via Ncheu to Lilongwe and the north. From Biriwiri, a seasonal road runs southwards to join the Blantyre–Mwanza road 78 miles away.

Minor roads, tracks and major footpaths within the area are shown in Fig. 2.

There are no airfields at present in use although there is a disused landing ground near Bawe Village, 10 miles north-west of Balaka station. The nearest serviceable airfields are at Dedza and Fort Johnston.

(b) Climate, Agriculture and Water Supply

Considerable variation in altitude causes major differences in climate between different parts of the area but, generally speaking, there is an increase in temperature and a decrease in rainfall eastwards from the Kirk Plateau at 5,000 feet to the Bwanje–Liwawadzi Valley at 2,000 feet.* The higher ground thus has a warm temperate climate whereas the lower areas, in common with a large part of the Shire Valley, experiences a climate bordering on the typical hot dry type.

The mean annual temperature at Toleza near Balaka is 75°F. On the Kirk Plateau the mean annual temperature is much lower and during the coldest months temperatures drop to freezing point. Rainfall varies from 31 inches per annum near Balaka to between 40 inches and 45 inches on the Kirk Plateau and flanks. Little rainfall information is available for the Liwawadzi, Kabudila and the eastern portion of the Bwanje catchments but from brief records at Bilila, mean totals appear to be in the region of 30 inches to 32 inches with probable increases in the Pirilongwe and Chiripa area. Apart from on the Kirk Plateau, less than one inch of the rainfall falls during the dry months from May to October.

Ground water conditions are very variable within the area and show considerable local fluctuation. In general, conditions are good in the colluvium-filled Liwawadzi–Bwanje Valley but become less favourable both westwards and eastwards where Basement gneisses are closer to the surface. On the higher ground, water is confined to narrow fault-zones, bands of pervious granulite or gneiss and local pockets of superficial weathered rock. The highest yielding boreholes are in the Bwanje Valley where the unconsolidated sediments form the only extensive aquifer in which a continuous, more or less planar, water table can be recognized. Even there, however, conditions are not ideal owing to the fact that the colluvium often has a high clay content which tends locally to inhibit the free flow of ground water thereby making it rich in dissolved salts and unpotable.

The pervious nature of the valley infillings is illustrated by the behaviour of the rivers draining the high ground to the west. As they pass from the relatively bare escarpment areas into the valley across the Bilila Fault they become markedly influent and many stop flowing completely before reaching the Bwanje. A section through the western side of the valley is shown in Fig. 3 and illustrates a number of features of interest:

(1) Towards the south-east there is a rapid increase in the thickness of the unconsolidated grey-brown sandy deposits which are taken to be valley infillings of both colluvial and alluvial origin.

(2) The yields of boreholes are consistently higher within the colluvium and may be up to 3,000 gallons per hour. To the north-west of Balaka yields average about 700 gallons per hour.

See Plate III for localities.

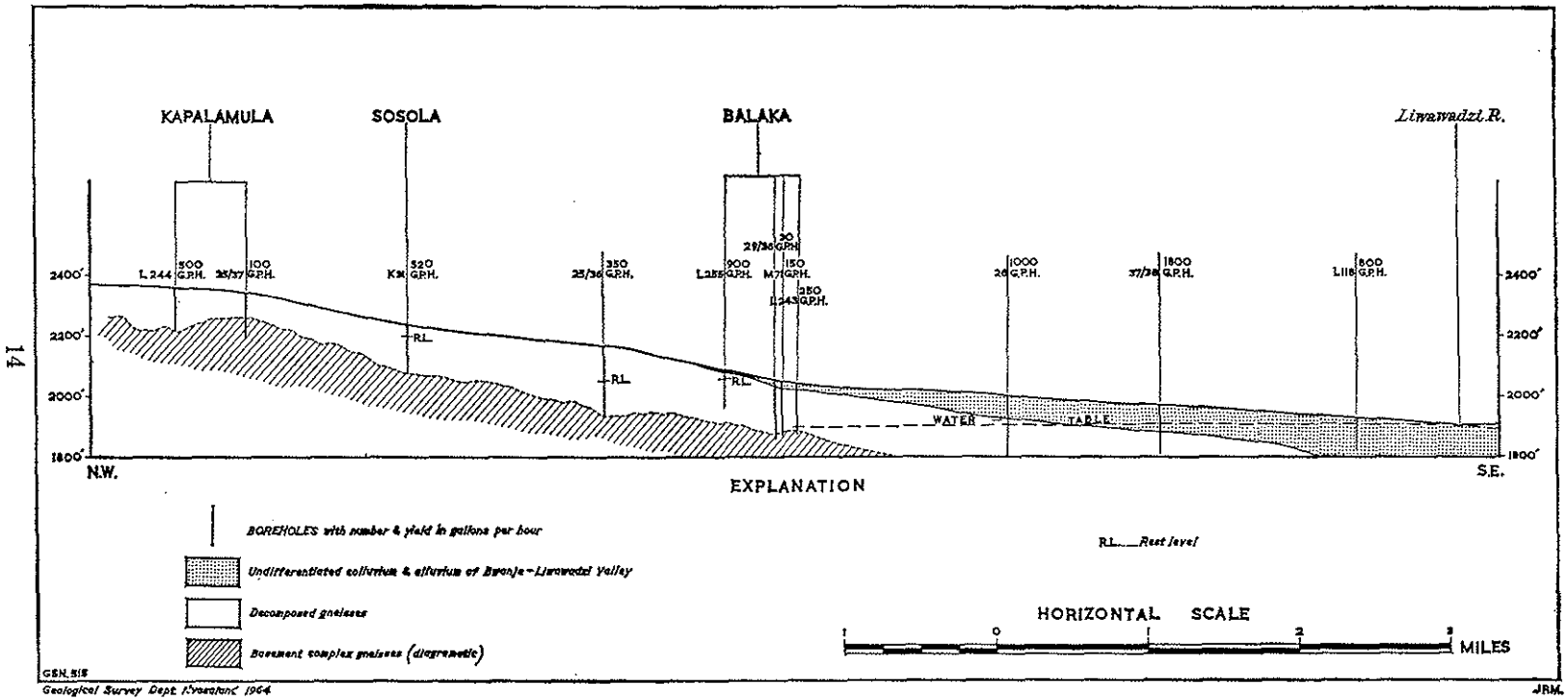

FIG. 3. Vertical section across the western side of the Liwawadzi Valley through Balaka.

(3) Although the boreholes were drilled at substantially different times the rest-levels of water in them appear to lie on one roughly planar surface which, if projected, outcrops in the Liwawadzi River. Thus there is a true water table within the colluvium in spite of the fact that many of the wells are slightly sub-artesian.

(4) To the north-west of Balaka, rest-levels reflect the irregular weathering of the Basement Complex gneisses and their heterogenity. In this direction gneiss outcrops become increasingly abundant but no exposures are seen in the opposite direction until the Liwawadzi is crossed.

The distribution of bored and dug wells approaches adequacy only in the areas underlain by colluvium but even there the local population experiences difficulty for at least two months of the year when the rivers are dry. North-east of the Bwanje, on the Chiripa Plateau, the lack of adequate water supplies is acute and this, coupled with a thin stony soil of poor quality, has resulted in this tract being thinly populated. Conditions improve southwards towards Balaka and a few satisfactory bored wells have been sunk between Mpasa Hill, Mbela and Zirimbuzi Hill.

West of the Bwanje–Liwawadzi Valley water supplies become gradually more plentiful towards the Kirk Plateau where surface sources are more important than underground supplies. Over the intermediate area, on the Nsipe–Livelezi Shelf, only two rivers, the Rivi-Rivi (with its tributary the Kapeni) and the Livelezi are perennial. All others run dry during October or November although small supplies can usually be obtained from shallow excavations.

All bored and dug wells are shown on the 1:100,000-scale geological map and details of the bored wells are given in Table I.

The principal crops of the area are maize, groundnuts, tobacco, cassava, with some cotton and a little rice. Sugar cane is commonly grown in the numerous *dambo*.* The Kirk Plateau is the country's main potato-producing area and also provides most other vegetables for the Southern Region markets. Cattle are extensively reared on the Nsipe–Livelezi Shelf especially in the Dombole, Ncheu and Dzunje areas where broad *dambo* provide good grazing. Apart from those on the Chiripa Plateau and on the escarpments, soils are generally good varying between heavy red clays, loams and sandy loams on the Plateau to black and grey sandy clays, silts and sands in the Bwanje–Liwawadzi Valley. The latter area is the most fertile and has scope for further development of exportable crops such as sun-cured tobacco, groundnuts and cotton.

(c) Natural Vegetation

The Bwanje–Liwawadzi Valley, in common with the Shire Valley and the lakeshore plains, is typical low-level thorn savannah interspersed with large timber trees. Among the most commonly occurring trees are *nsangu* (*Acacia albida*), *tsanya* (*Colophospermum mopane*), *napini* (*Terminalia sericea*), *ngwalangwa* (*Hyphenae* palm), *mwemba* (*Tamarindus indica*), *mlambe* (*Adansonia digitata*, or baobab). Patches of *Euphorbia* sp. appear on the poor stony soils towards the Chiripa plateau where the low savannah is gradually replaced by *Brachystegia-Isoberlinia* open woodland. On the Nsipe–Livelezi Shelf only remnants of this woodland, which must have once been extensive, have survived the widespread cultivation.

On the higher Kirk Plateau *Brachystegia-Uapaca* woodland gives way to rolling grassland with only a few scattered short trees and bushes but with a variety of flowering herbs and patches of bracken. Locally, within hollows, there are patches of thick forest characterized by *mbawa* (*Cordia abbyssinica*) associated with palms

*Chinyanja–Broad, grass covered swampy valley.

TABLE I

BOREHOLES IN THE NCHEU-BALAKA AREA

Number	Locality	Depth (ft.)	Yield (g.p.h.)	Rest. level
26/35	Ntundu	211	500	108
28/36	Balaka	237	350	125
29/36	Balaka	287	700	145
33/36	Chikande	170	1,000	67
34/37	Mwaya	229	1,000	152
35/37	Kapalamula	142	100	82
M71	Balaka	182	150	138
M77	Balaka Market (Loji)	95	400	40
M78	Chisonthe	150	600	60
M83	Chitsulo	140	850	75
M84	Masikamu	175	450	—
M87	Kantandilo	150	1,000	85
M112	Kandeu	114	820	9
M114	Mileni (Kaimamaima)	130	1,000	—
M119	Kasinje	125	600	—
G43	Bwanje Valley	286	400	—
G44	Bwanje Valley	260	500	103
G50	Bwanje Valley	230	500	110
G52	Mile 95 Railway	220	250	130
G55	Mile 95 Railway	180	350	95
G86	Ncheu Boma	120	350	40
G87	Mphate	110	600	36
HD135	Khola	80	600	18
L120	Mpezeni	120	340	35
L144	Simon Chitendere	113	115	70
L243	Balaka	176	250	120
L244	Kapalamula	130	500	63
L251	Bemvu	120	410	61
L252	Gumbe	75	500	24
L253	Balaka	203	900	150
L254	Chikandenji (Msudzu)	110	430	39
L255	Matola	125	700	35
L257	Nsipe F.M.B.	105	790	48
L276	Austin	137	820	13
L277	Namakoko	208	1,300	45
L399	Mikundi	140	400	70
L427	Ncheu	151	250	21
L428	Ncheu	151	380	65
L429	Ncheu	132	1,100	22
E51	Biriwiri Customs	105	1,200	6
E65	Chiripa F.M.B.	100	720	28
E66	Tsamilani	150	500	70
E67	Nthumbwe	140	400	32
W8	Mpira School	147	360	14
W100A	Magombe	165	300	100
W104	Kasinje	150	1,200	31
W107	Nasala	160	960	81
W109	Phanga	121	700	20
W109	Chikule	—	—	—
J4	Mwanga	125	900	52
J5	Kwitanda	150	400	42
J6	Toleza	130	2,000	25
A5	Matola	131	800	14
A96	Kuthemba	187	650	82
K31	Sosola	160	520	50

TABLE II

DUG WELLS IN THE NCHEU-BALAKA AREA

Number	Locality	Depth (ft.)	Yield (g.p.h.)	Rest. level
38/36	Kasinje	40	450	24
39/36	Kambewa (Mitongwe)	46	400	20
40/36	Saulo (Kasinje yangono)	65	300	54
41/36	200 yds. W. of Railway at 98 m.	69	300	57
42/36	1 m. N. Sharpevale Station (Zalengera)	102	250	97
43/36	Nanyangu Stream	73	100	56
44/36	Pangala Stream	49	150	49
45/36	Bwanje Valley	41	50	33
46/36	Bwanje Siding	101	100	97
47/36	E. of Sandi	51	112	42
48/36	100 yds. W. of Railway at 91 m.	117	50	100
49/36	Chiwita	69	80	44
50/36	Mpika Stream	70	100	53
51/36	Pendanyama	42	100	36
52/36	Tambala	71	34	66
53/36	Tambala	41	100	31
54/36	Majiti Stream	56	114	44
55/36	Penga Penga	50	216	38
56/36	Hola	50	130	42
57/36	Chinsonte	84	100	69
58/36	Akokola	48	113	37
59/36	Chibalala	61	80	50
60/36	Banda (Farringdon)	29	215	27
61/36	Funsani	17	150	12
62/36	Kalimanjila	22	400	19
63/36	8 m. N. Balaka	39	76	28
4/35	Upper Liwawadzi	64	90	40
5/35	Mute-Liwawadzi confluence	40	200	34
6/35	Mapondera	23	134	17
7/35	Toleza	28	200	21
9/35	Chimatilo	35	83	28
10/35	Moia-Moia	27	350	22
11/35	Misanjo	22	40+	16
12/35	Milioni	100	100	90
13/35	Zamimba (Ndosa Halt)	122	55	104
14/35	Malakata	36	60	32
15/35	Mpeseni	87	40	75

and evergreens. Air from the south-east, rising up the steep Chirobwe scarp has caused high rainfall and has resulted in thick rain forest on the crest and eastern slopes.

(d) Settlement

The area is heavily populated and has been extensively cultivated so that little indigenous woodland remains. No reliable figures are available for the population density but taking the area as a whole there are probably between about 70 and 90 persons to the square mile. The density rises in the Ncheu and Balaka areas which are thickly populated and falls on the arid Chiripa Plateau and parts of the cold, wet Kirk Range. Settlement is prohibited in the Pirilongwe, Mvai, Bangwe and Dzonze forest reserves.

The people are of mixed tribes but mainly Ayao and Angoni between whom there has been considerable intermarriage. In parts of the area these two tribes, who speak quite different languages, have given different names to certain hills and streams. This happens most consistently in the Chiripa area and on the geological map the Angoni names have been used as Chingoni is the more common language over the rest of the area.

II. PHYSIOGRAPHY

The area shows striking physiographic variation resultant from its position on the western side of the Nyasa Rift Valley and clearly displays the typical " shelf and scarp " topography associated with rifting. This has made four distinct physiographic units readily discernible as follows:

(a) The Kirk Plateau which lies between the international border and the Kirk Range scarp and merges into the Angoniland Plateau to the north.

(b) The Nsipe–Livelezi Shelf which extends from the foot of the Kirk Range scarp to the lower scarp overlooking the Bwanje Valley and which has been faulted in the south to form an additional step: the Kanzati step.

(c) The Bwanje–Liwawadzi Valley.

(d) The Chiripa Plateau which continues beyond the eastern boundary of the present area to the Lake Malombe scarp.

Between the Kirk Plateau and the Nsipe–Livelezi Shelf in the vicinity of Ncheu is a further unit, the Ncheu Step, undeveloped elsewhere in the area. All the units are shown on the structural map, Plate III (facing p. 71).

(a) The Kirk Plateau

This forms the highest ground within the region mapped but only a small part of the plateau lies within Malawi the remainder stretching westwards into Mozambique and Zambia. It lies at altitudes between about 4,500 feet and 5,500 feet locally rising above 6,000 feet as on Chirobwe (6,638 feet), Mvai (6,192 feet), Dzonze (6,086 feet), which are hills and ridges of resistant horizons on the Basement Complex accompanied by lower, not less prominent peaks such as Mtanda (5,415 feet), Maone (5,713 feet), Sanjika (5,542 feet), Kapiridimba (5,600 feet). Otherwise the surface is gently undulating and of moderate relief near to the border road but it becomes deeply dissected towards the east. This zone of high relief, adjacent to the fault, is generally about a mile wide, but widens to four miles towards the south where the main Rift wall is less discernible.

The eastern boundary of the Plateau is a magnificent eastward facing escarpment that is best developed in the north, immediately east of Chirobwe Mountain, where there is a precipitous drop of 3,000 feet over 1.4 miles (measured horizontally), an average slope of 1 in 2.7. Chirobwe peak, which surmounts this escarpment, thus provides magnificent vistas over southern Malawi. Southwards the scarp diminishes rapidly in height towards Gowa Mission where it is less precipitous and about 1,000 feet high. At Gowa it is offset to the west and continues in a new direction, SE. instead of SSE., the direction it maintains from Chirobwe. Towards Chiole Mission there is a further height reduction to about 100 feet and the slope becomes more gentle.

Beyond Chiole the scarp becomes barely noticeable but appears again with a height of 300 feet south of the Mpamadzi River near Bemvu from whence it begins to swing to the SSE. before disappearing after a few miles.

The scarp at the southern extremity does not mark the true edge of the Kirk Plateau, however, because two miles to the west a further, much bolder feature rises some 2,500 feet from 3,500 feet to 6,086 feet, the summit of Dzonze Mountain, over a distance of just less than two miles. This is the true Kirk Plateau boundary

in this part of the area and was found by Bloomfield and Garson (1964) to continue to the south. Northwards, this western scarp is traceable as far as the Rivi-Rivi where it appears to swing to the north-west and run parallel to and just to the south of the river along the strike of the Basement gneisses. Beyond the Rivi-Rivi an escarpment running NNW.–SSE. is discernible on the contoured 1: 50,000 map truncating the south-eastern end of Mvai Mountain. This scarp is in line with that at the foot of Dzonze to the south and may continue northwards as the north-eastern face of Sanjika Mountain after which it becomes indistinct but apparently merges with the Chirobwe scarp north-west of Dombole Mission. Thus between Dombole Mission and the extreme south-eastern corner of the area there is a dissected shelf of country lying at between 3,000 and 4,000 feet intermediate in height between the Kirk Plateau and the Nsipe–Livelezi Shelf. At its southern end this minor shelf, which Alexander recognized and called the Ncheu Step, merges with the Nsipe–Livelezi Shelf. The main Rift wall, the step's western boundary, has been breached by the Rivi-Rivi which has cut a valley some two miles wide and 1,000 feet deep into the high plateau.

As the border road follows the watershed the rivers draining the Kirk Plateau all flow eastwards or south-eastwards into Malawi. North-west of Dombole they form part of the Livelezi system which drains northwards into the south-west arm of Lake Malawi but south-east of Dombole they are part of the Nsipe–Rivi-Rivi system which flows south-eastward into the Shire River. The Rivi-Rivi itself rises on the summit ridge of Mvai Mountain and drains south for two miles until it reaches a relatively weak horizon of graphite quartzofeldspathic granulite a mile north of Nzama Mission. It then swings ESE. following the strike of this horizon for 11 miles, crossing the Ncheu Step and emerging on the Nsipe–Livelezi Shelf a mile WNW. of Kanzati. The Rivi-Rivi has eroded a steep-sided valley into the weaker formations upon which it runs and between Nzama (at about 4,600 feet) and Zipirana Village, where it is joined by its tributary the Mpira, it drops 1,400 feet at an average gradient of 1 in 26. In this section of its course it is hemmed in by rugged, deeply dissected hills to the south and by the south-east extension of the Mvai Range to the north. Its southern tributaries rise on the lip of the Angoniland Plateau and descend as consequents transversely to the strike of the gneisses in valleys which grow progressively steeper towards the Rivi-Rivi. These streams are still in a youthful phase but the development of subsequents has progressed far enough to result in the capture of headwaters of some streams. This is notable in the case of the Mwasambwe which has captured the main tributary of the Malope, now represented by the insignificant Nsadamwana Stream at Jenya Village.

The Mpamadzi River rises on the Angoniland Plateau at Kamwuzeni Village and flows south-east between Mvai and Sanjika mountains. For the first 1½ miles of its course it runs in a shallow valley but then its bed rapidly deepens and it drops 800 feet in the next three miles, a gradient of 1 in 20, to Mpira School. From there its valley shallows and drops only 500 feet in the next six miles as far as its confluence with the Rivi-Rivi. The course of the Mpira follows a relatively soft formation of quartzofeldspathic granulite which carries the main Zomba–Lilongwe road up to the Angoniland Plateau, and the range of hills stretching south-east from Ncheu Mountain. Its valley is very shallow in its upper reaches and is hardly more than a slight hollowing of an otherwise bevelled surface until it reaches a point four miles south-east of Ncheu Boma. It then rapidly deepens and becomes steep-sided for four miles before flowing into the Nsipe River.

(b) The Nsipe–Livelezi Shelf

The Nsipe–Livelezi Shelf runs diagonally across the area from north-west to south-west and is best developed in the vicinity of Dombole Mission. It is an almost flat surface at an altitude of between about 3,500 feet and 2,500 feet but it

has been deeply dissected in certain areas adjacent to its eastern boundary scarp. This scarp overlooks the Bwanje–Liwawadzi Valley to the east and diminishes in height and splendour southwards from Mitongwe to Balaka where it is barely noticeable (Fig. 3). Several hills of resistant Basement rocks rise above the general level of the plateau as on the Angoniland surface to the west. The highest of these is Dzunje (4,287 feet), formed of syenite, and others include Kambironje (3,912 feet), Kambewe (3,952 feet), and Bangwe (3,907 feet).

Running roughly east-west across the surface from Dombole Mission to Peter Village, 2½ miles north of Dzunje Hill, is a low watershed separating the rivers draining northwards into the Bwanje and Lake Malawi from those flowing south into the Liwawadzi, Rivi-Rivi and the Shire. From Peter Village this watershed swings to the south-east towards Bilila skirting a series of streams which begin flowing to the south but eventually change direction to the north-east and flow into the Bwanje.

Of the streams flowing to the north, the major one is the Livelezi which rises on the Kirk Plateau at Patsalabanda Village, flows generally north-eastwards as far as Muluma Hill and then swings to the NNW. which general direction it maintains to the northern boundary of the area. It occupies a broad shallow valley overlooked to the west by the Chirobwe scarp and to the west by an elevated strip of country which separates it from the Liwadzi and which continues northwards as the Kambironji group of hills. The Liwadzi (not to be confused with the Liwawadzi) and its neighbours the Nanyangu, Pangala and Nthunduluza have all cut much deeper into the shelf and occupy deep gorges as they approach the eastern boundary fault. The Liwadzi gorge just south of Mitongwe Estate is at least 100 feet deep, the river bed lying some 600 feet below the summit of the confining hills. All the north-flowing rivers of the shelf show some dependence on the structure of the Basement; those to the east more so than the Livelezi. The Liwadzi closely parallels the strike of the Basement gneisses over the whole of its course on the shelf but slowly swings to the east as it crosses the Bwanje Valley sediments. In the hills north of Kandeu, drainage has been strongly influenced by a series of parallel, east-west, joints along which the streams have cut deep valleys.

South of the Dombole–Bilila watershed the surface falls gradually in height from about 3,500 feet to 2,000 feet towards Balaka where it merges with the Liwawadzi Valley, the eastern boundary fault having died out and no longer forming a division between the two units. In this southern area, between Kanzati Village and Balaka the shelf has been disturbed by a fault which has produced two distinct levels separated by a low eastward facing fault-scarp some 200 feet high running south-south-west from Bawe. At Bawe the scarp is barely visible and rapidly disappears to the north but southwards it increases markedly in height and continues into the Senzani area as the Sikulumowa Fault (Bloomfield and Garson, 1964). The effect of this fault has been to produce a further step, the Kanzati Step, intermediate in height between the southern end of the Ncheu Step and the Nsipe Step. A section between Dzonze and Balaka Market therefore shows five distinct levels instead of three as in the greater part of the area to the north (Fig. 4).

Several major streams mainly flowing to the south-west and separated by fairly low watersheds cut the southern portion of the Nsipe–Livelezi Shelf. Most important among these are the Nsipe and Nkame, both of which join the Rivi-Rivi. They roughly follow the strike of the Basement gneisses, especially the latter, which south-east of its confluence with the Nsipe, has been strongly influenced by the structure of the Basement, following the strike over long stretches. The Rivi-Rivi has cut a deep channel into the gneisses immediately west of the Sikulumowa Fault which suggests that it has been rejuvenated fairly recently by movements along the fault.

A further group of streams among which the Linengwe is notable, flows over the eastward facing Bilila Scarp to join the Liwawadzi. The Linengwe, rising in the vicinity of Dzunje Mountain to the west of Penga-Penga closely follows the southern boundary of a broad belt of quartzofeldspathic gneisses and granulites to within a mile of the old Loji–Farringdon road. Here it turns abruptly through 90 degrees and flows directly towards the edge of the plateau at right angles to the strike of the gneisses, cutting a deep gorge, and emerging on to the plain below one mile west of Farringdon. The most likely explanation of this sudden change in direction is that an original river rising immediately west of the plateau edge has captured a stream that may once have been a tributary of the Nkhame. The original lower part of this tributary may now be the Naciteme Stream.

The depth of weathering over the whole shelf is variable and is at a maximum between the railway and the Sikulumowa Fault and over most of the Livelezi Valley. Here thick red sandy clays are extensively developed and good exposures of fresh rock are confined to the streams.

(c) The Bwanje–Liwawadzi Valley

This unit forms a narrow belt running obliquely across the area from Kasinje to Balaka and consists of a flat featureless valley some four miles across drained by the Bwanje in the north and the Liwawadzi in the south. The Bwanje Valley is a continuation of the south-west arm of Lake Malawi and is similar and parallel to the Upper Shire Rift Valley 30 miles to the east. It dies out southwards towards a very low watershed, which separates it from the Liwawadzi Valley and which is a continuation of the Nsipe–Livelezi Shelf watershed between Dombole Mission and Peter Village. The Bwanje–Liwawadzi watershed, however, is much less apparent and barely noticeable on the ground but becomes more discernible in terms of heights above sea level. From Lake Malawi at 1,550 feet there is a gradual rise to Bilila at 2,288, a gradient of 1 in 286 and then a fall towards Balaka which stands just above 2,000 feet, a gradient of 1 in 450.

The boundary of the Bwanje–Liwawadzi Valley is marked to the east by a striking fault-scarp which is very conspicuous on the aerial photographs and which may be traced, without major breaks, from just west of Chitendere Village to the northern boundary of the area beyond which it continues for another 50 miles or so as far as the Lintipe River 12 miles WSW. of Salima. The height of the scarp is about 15 feet in the south rising to 50 feet north of Kasinje and it is surmounted by a narrow shelf of variable width but normally not more than 100 yards above which the ground rises over a mile or so to the Nsipe–Livelezi Shelf. The steep and fresh nature of the scarp suggests that it has resulted from recent movement along a pre-existing fault, the higher more eroded escarpment having been produced by earlier movement of greater magnitude. From Chitendere Village the fault-scarp swings to the south and diminishes rapidly towards Balaka where it may be represented by the slight increase in gradient immediately west of the railway.

The eastern boundary of the Bwanje–Liwawadzi Valley is much less clearly defined. There is no evidence of a fault-scarp and the ground rises gradually eastwards towards the Chiripa Plateau. This slope is well displayed beyond the Liwawadzi bridge on the road from Balaka Station to Fort Johnston and also on the Farringdon to Fort Johnston road between Chipalala and the Nankulukuti group of hills.

The Bwanje River itself follows a winding course and has eroded a channel into soft, unconsolidated alluvium and colluvium which fills the whole valley but through which Basement gneisses occasionally protrude. Numerous subsequent streams drain the plateau on either side but much of their flow is lost to the alluvium and colluvium before it reaches the Bwanje which is therefore not perennial.

The Liwawadzi River with its tributaries the Linengwe from the Nsipe–Livelezi Shelf and the Mute from the Chiripa Plateau flows southwards in an intricately winding channel to join the Rivi-Rivi near the Chenkumbi Hills to the south-east of Balaka. Near Austen Village, at least one of the upper tributaries of the Liwawadzi has been captured by the Bwanje.

(d) The Chiripa Plateau

From the Bwanje–Liwawadzi Valley north-eastwards and eastwards the Chiripa Plateau extends to the margins of the present area and continues to the scarp overlooking Lake Malombe. In the area under discussion this physiographic unit takes the form of a very mature surface gently rising from about 2,500 feet bordering the Bwanje Valley to about 3,000 feet on the plain surrounding Pirilongwe. It has low, broad watersheds studded with prominent and isolated hills such as Nankulukuti (3,308 feet), Pirilongwe (5,098 feet), Mpasa (3,559 feet), Zirimbuzi (2,600 feet), Migula (2,849 feet) and Nampiri (2,707 feet). The drainage is locally completely independent of the structures in the Basement gneisses but elsewhere these have strongly influenced the drainage pattern. On the south-western part of the plateau the rocks have been deeply weathered and blanketed with thick residual deposits which merge southwards with the alluvium of the Liwawadzi Valley. Elesewhere the depth of weathering is not great and soils are of extremely poor quality.

The direction of drainage is more or less radial from the Nankulukuti–Chiripa area with streams such as the Liwawadzi and Mute flowing south, the Mpika and Msasa running west to the Bwanje, and the Kabudila with its various tributaries flowing to the north. In the north-west the plateau is modified by the impressive granite mass of Pirilongwe composed of a group of hills and ridges reaching approximately to the same level but dominated by an imposing main peak. The massif is approximately square in plan and about four miles across and is bounded by precipitous slopes which are especially steep to the east and west and which form sharp angles with the surface below. The scarp, to the west, overlooking the Kabudila River has the appearance of a fault-scarp but there is no evidence to show that it is such.

Generally, the streams such as the Mpika, Msasa, Dombe and Bwerela flowing westwards into the Bwanje, have not been affected by the underlying Basement structures which suggest that the sediments of the Bwanje Valley once extended much further east; at least as far as the present Bwanje–Kabudila watershed. The Kabudila River, however, does show some conformity with structural trends in the gneisses. Rising on the western slopes of Pirilongwe, it flows south but gradually swings west following the boundary between biotite-gneisses and quartzo-feldspathic granulites. Due south of the Pirilongwe main peak it cuts across the strike of the biotite-gneisses to flow along a fault for about two miles, finally swinging north-west and maintaining this direction to the edge of the area. In the last five miles of its course it occupies a very broad shallow valley partially infilled with alluvium.

(e) Age and correlation of the surfaces

No definite conclusion on the physiographic and structural history can be drawn from evidence within the area due to a lack of post-Basment sediments of known age, and interpretations must be based on comparisons with other areas both within and outside Malawi where the faulting, warping, tilting and general uplifts can be more precisely dated.

Dixey (1938, 1941, 1960) after an intensive study of the physiographic history of Africa has arrived at a sequence of events which could broadly explain the present configuration of the Ncheu–Balaka area. He believes the Rift structures

in Malawi to have been initiated in the Karroo or " early post-Karroo " as basins of deposition, largely tectonic in origin, the positions of which were controlled by the structure of the Basement. At the beginning of the Cretaceous the surface which had by that time developed was further disturbed by rifting and probably regionally uplifted following the disintegration of Gondwanaland resulting in the erosion of the Karroo sediments and the development of a secondary " valley-floor " peneplain on the site of one of the old Karroo basins. Depression then followed causing this valley to be infilled with Cretaceous and possibly Eocene sediments accompanied by a continuation of rift faulting. Further peneplanation culminating in about mid-Miocene times produced a new surface studded with remnants of the higher parts of the early Cretaceous surface but on which relief was generally reduced to a minimum. King (1962) considered that moderate epeirogenic uplift in two stages then caused the removal of the Cretaceous valley fillings and a resurrection of the old pre-Cretaceous Valley floor. Powerful uplift in the late Pliocene continued to the present time and gave rise to the Rift Valley system that is seen today on the crests of continental upwarps (*loc. cit.*).

In the Ncheu–Balaka area Dixey's pre-Cretaceous surface (King's Gondwana) may be represented by the summits of Dzonze, Mvai and Chirobwe, his mid-Miocene surface (King's " African ") is the Kirk Plateau, and the resurrected pre-Cretaceous valley floor would correspond to the Bwanje–Liawawadzi Valley. The Nsipe–Livelezi Shelf, the Kanzati Step and the Chiripa Plateau are probably fallen splinters mid-Miocene in age, formed in a similar manner to the Neno, Mwanza and Chileka steps in southern Malawi by late Tertiary or even Quaternary faulting.

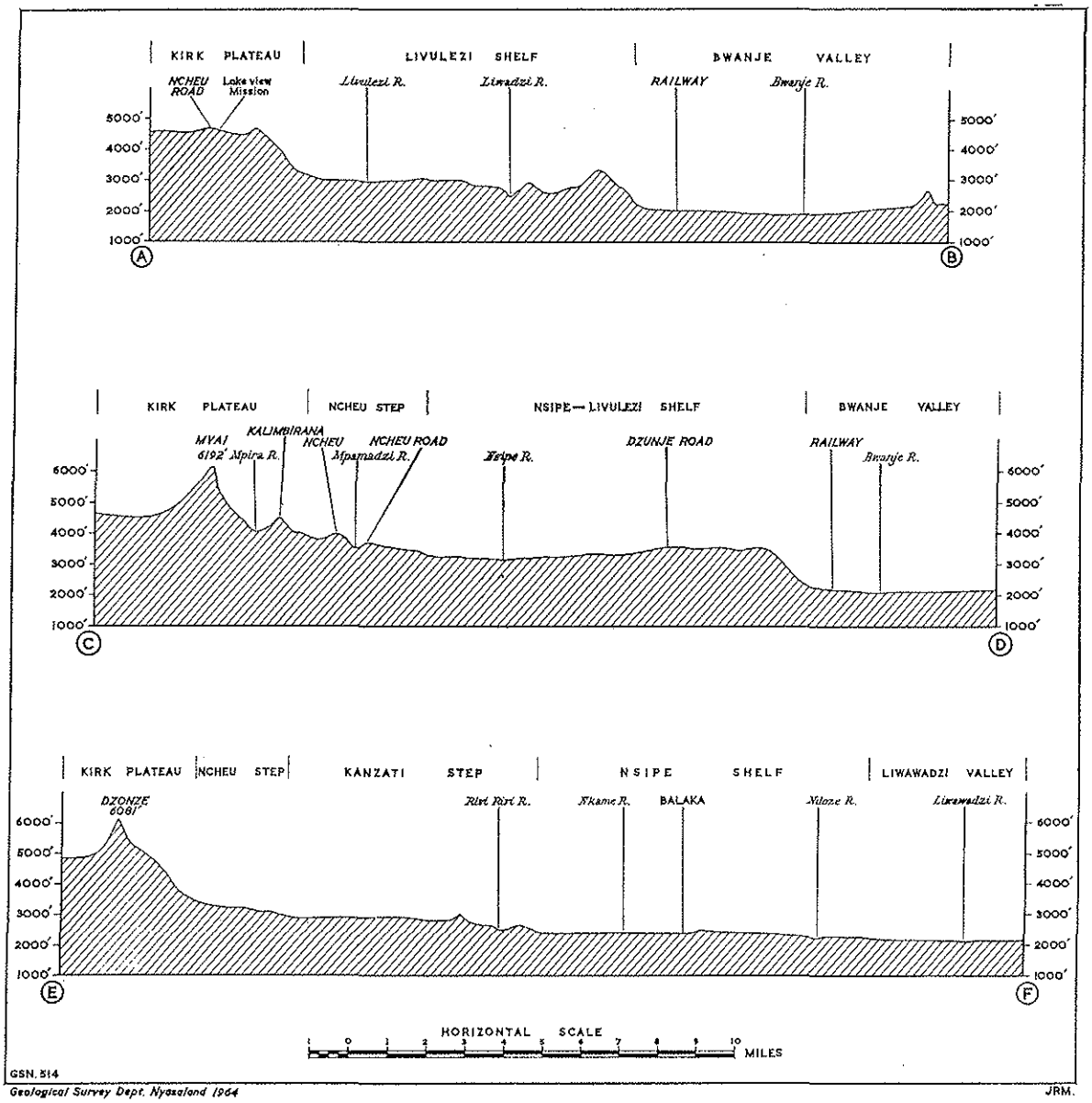

FIG. 4. Vertical sections illustrating the physiography of the Ncheu-Balaka Area.